CHURCH OF THE HOLY SEPULCHRE

JERUSALEM

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STRUCTURAL SURVEY
FINAL REPORT

BY

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WITH AN INTRODUCTION BY
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MOSAIC OF CHRIST IN GLORY FROM LATIN CALVARY VAULT

Frontispiece to Introduction

INTRODUCTION

THE Church of the Holy Sepulchre contains examples of men's handiwork that span a period of more than nineteen centuries. Of these works the latest in date were carried out during the present year, and the earliest are represented by whatever traces of the original Sepulchre may have survived the depredations of so many centuries, and by an ancient tomb situated immediately to the south of the Jacobite chapel in the western apse of the Rotunda. The internal surfaces of this tomb are in part rock-cut, and in part formed by the original Constantinian masonry of the Rotunda, the north side of this tomb having been cut through when, in the fourth century, the foundations of the Rotunda, or Church of the Resurrection, were laid.

The Crucifixion was carried out near the Sepulchre, and the region in which it occurred is referred to in the Gospels as a 'place'. Golgotha, or the 'Place of the Skull', was a space of land situated outside the wall of the City. In it Joseph of Arimathea owned a small property. Both the Sepulchre itself, and the actual site of the Crucifixion, were included in this 'place' or space of land, and were near to one another. In the same area were other tombs, and also plantations referred to in the Gospel of St. John as a 'garden'. The wall of the City ran to the south and to the east of Golgotha. In the section to the east of Golgotha was a gate through which a road ran westwards past the site of the Crucifixion.

About fifteen years after the Crucifixion Herod Agrippa extended the City by building the 'third wall'. From this time onwards the Garden of Joseph of Arimathea, with Calvary and the Sepulchre of Our Lord, as well as the mausoleum of John Hyrcanus and two groups of Jewish tombs discovered near the Church were enclosed within the City walls.

The siege of Titus (A.D. 70–1), followed some two generations later by the suppression of the Jewish revolt under Bar

Kokhba, together resulted in the ruin of ancient Jerusalem, and in the construction by Hadrian in 135 of the Roman city called Aelia Capitolina on a part of the ancient site. The Forum and Capitol of this colonial city were built over the region of Golgotha. The irregularities of the site necessitated a measure of levelling up, by covering with earth, or other transported materials, both the Sepulchre and Calvary. Henceforward it was impossible for Christians to visit these places, until the Emperor Constantine decided, some two hundred years later, to demolish the Capitol and architecturally to glorify the sites that had so long been hidden.

Calvary at that time was a rocky mound; west of it there was a dip in the land and, beyond that dip, the ground rose more steeply towards the west. In that rise was the Sepulchre, a rock-cut tomb lying, not due west of Calvary, but a little to the north of west. Constantine's architects isolated the rock that immediately enclosed the Sepulchre by quarrying away all the non-essential material round it, thus leaving the Sepulchre standing up from a rock floor which was a little lower in level than the Sepulchre's floor and which extended over an area sufficient to provide an even space whereon to erect the enclosing walls of the Constantinian Anastasis, or Church of the Resurrection, which was given the circular form it still retains.

The mound of Calvary, also, was brought to a regular shape and sufficient size by cutting away the superfluous rock that formed its slopes. This was done for the obvious architectural purpose of emphasizing this second essential feature of the site, a feature that had to be reduced to some regular shape to make it accord with the architectural lay-out of its surroundings. After this operation the Rock of the Cross, as it was called, stood up above its surrounding floor-level some four to five metres, and was enclosed by a grille. It stood as a separate monument, necessarily outside the major axis (which ran east and west) of the whole architectural conception, and on the southern side of a colonnaded court constructed to the east of the Anastasis. East of this court a great Basilica or Martyrium

was built. The present Chapel of St. Helena formed the 'crypt' of this Basilica. The Basilica's main entrance was to the east, where access was provided through a colonnaded atrium or fore-court, reached from the main street that ran north and south through the city of Aelia. The line of this street is identical with that of the existing *Khan al-Zeit*; and to the west of it, and behind some buildings bordering the street, can still be seen something of the great Constantinian Entrance Doorways that led into the Basilica's fore-court (see Figs. A and B).

The Church we see to-day is the latest successor to a line that goes back for sixteen centuries. It was sixteen centuries ago that it first became possible for Christians to give adequate architectural expression to their natural veneration for these sites (which, indeed, they had not been able even to see since the year 135), and to their conviction that it was proper and necessary that monuments in their honour should here be erected. That conviction has remained firmly rooted in the minds of Christians for more than fifty generations; so firmly, that it has always succeeded in remanifesting itself, in some form, even after the worst disasters due to natural causes and to demolitions prompted by religious animosity and fanaticism; though it has never been possible entirely to thwart the act of giving some sort of practical architectural expression to the desire generated by that conviction, the splendour or poverty of the expression has varied, of course, with the changing political and economic conditions of different ages.

Under Constantine the Great, the wealth and the technical skill of the Empire were available for the provision of craftsmen equally from the west and from the east. After the destruction of Constantine's work by the Persians in 614, the financial difficulties that faced the then Patriarch, Modestus, were considerable, and the funds available did not allow a reconstruction on a scale of anything like the same grandeur, though it was carried out on the same general lines as those followed by Constantine.

Conditions in no way improved when the country passed, a few years later, under Moslem rule. In the eighth century (746) a great earthquake increased accumulated dilapidations. The local Christian community, already impoverished by taxation and other exactions, were unable themselves to supply the funds needed for reconstruction. In the ninth century conditions improved under the protectorate established by Charlemagne by arrangement with the Abbasid Caliph at Baghdad. Considerable sums reached Palestine from abroad and the country enjoyed a period of prosperity unknown since the time of Justinian. Throughout the remainder of the ninth century conditions continued to be favourable, and the maintenance of the church was made possible by subscriptions from abroad.

In the tenth century, a new period of trouble began. The power of the Abbasid Caliphate at Baghdad had already declined in the previous century, and the real control had passed into the hands of a military bodyguard of Turkish origin. The former unity of the Moslem empire was broken. A rival (Fatimid) Caliphate was established in northern Africa. The lack of unified and effective control brought disorders to Islam. In the tenth century the Karmathians made an inroad into Palestine; they also made the pilgrim routes to Mecca dangerous, and the numbers of Moslem pilgrims to Jerusalem increased. The conditions of anarchy reacted in a manner very unfavourable for Christians in Jerusalem; in 935 a mosque was built on the site formerly occupied by the Constantinian atrium of the church. In 938 riots occurred on Palm Sunday, and fire and pillage damaged the Holy Sepulchre. The successes of the Byzantine Emperor Nicephorus Phocas, and particularly the peace he concluded in 967 with the Fatimid Caliph in Africa against the Ilshidite Turks in Egypt (who also held Palestine and Southern Syria) exasperated the local Moslems who, helped by the Jews, set fire to the Anastasis and burnt the Patriarch John.

A generation later, when the Fatimids had extended their

power to Egypt and to Palestine, the church was destroyed (1009) by the eccentric Fatimid Caliph al-Hakim. Between 1027 and 1048 conditions again improved owing to a protectorate established by the Byzantine Emperors, and in the latter year the church was rebuilt. It was this church, as rebuilt by the Emperor Constantine Monomach, that met the eyes of the Crusaders when they captured Jerusalem in 1099.

They found the Holy Sepulchre surrounded by a circular structure consisting of four groups of three columns each, alternating with three groups of two piers each. This circular colonnade was surrounded, on the western half, by an ambulatory, the outer wall of which contained three apses, while an apsed presbyterium or choir-like place for the clergy and containing the principal altar, faced the Sepulchre to the east. East of this was a court on the southern side of which stood the Calvary Rock (standing to the height 'of a lance') and the Chapel of Adam. Above the south-east bay of the present Calvary Chapel there is a vault of Byzantine character. Of the mosaics that once decorated this vault there remains a very fine panel, elliptical in shape, and representing Christ in Glory (see Frontispiece). This mosaic is also Byzantine in character though the work may well have been carried out during the Crusader period. To the south of the Court was the Parvis, and to the west of the latter, the Chapel of St. John, the Baptistery, or Chapel of the Holy Trinity, and the Chapel of St. James. North of the Holy Sepulchre was the Chapel of St. Mary. The omphalos indicating the centre of the world (still marked in the present Basilica) was in the court east of the Presbyterium apse. Under the ruins of Constantine's Basilica was the crypt of St. Helena. The Crusaders repaired and re-roofed this crypt, and built their own Basilica, which still stands in spite of eight centuries of neglect and many acts of vandalism, between St. Helena's Chapel and the Rotunda, connecting it with the Chapel by a stairway and with the Rotunda by a Triumphal Arch. They designed

their church to cover under one roof the Rock of Calvary and the area formerly occupied by the court to the east of the Rotunda.

The plan of this church is to be regarded as a whole; the Rotunda or Church of the Anastasis and its annexed Basilica, or 'Chorus Dominorum', forming part of a conception wherein the Rotunda takes the place normally occupied by the nave of a Cathedral. Immediately east of the Rotunda, or nave, is the transept, in the southern arm of which is the main entrance. The middle bay of the transept is a 'crossing' covered by a dome. East of the latter is the Choir with an apsidal eastern end and an ambulatory round it and connected with aisles to the north and south of the Choir. The Calvary Rock is in the chapel south of the southern aisle and immediately to the east of the main transeptal entrance.

The Crusaders respected and preserved the work of their predecessors so far as was compatible with their scheme of enlargement. They retained a dome of Byzantine workmanship at the south-east corner of the roof, while in the northern aisle of their church they preserved a row of Byzantine columns and utilized the wall to the north of those columns as the northern wall of their own church, adapting it to their purposes by piercing windows in it.

One of the main causes of dilapidations has been the large number of earthquakes. At least fifteen of comparatively grave character have occurred since the building of Constantine's monuments, and twice that number of other shocks figure in historical record, while slight tremors are experienced every year. Between the Crusader occupation of Jerusalem and the dedication of the church in 1149, six shocks were felt, and it seems probable that the builders recognized this as a factor to take into account in the construction of their main walls, whose upper parts were set slightly back from the lower.

Since its erection the Crusaders' church has, in addition to earthquakes, suffered from fire, from neglect, and from certain

works carried out in 1810 which will later be described in their historical sequence.

In consequence of all this the exceptionally fine character of the church is obscured. But it is still possible by careful examination to gain some appreciation of the architectural ingenuity, of the constructional skill, and of the perfection of workmanship in matters of detail, that were shown by the original builders. So much of this is, in point of fact, still recoverable, that, were it possible to remove the plaster botching which conceals much admirable detail, carefully to repair all that is left and is now concealed of the original work, and to reopen windows for the most part blocked up, a considerable measure of its former beauty and character could be given back to the church.

After the defeat of the Crusaders in 1187 at the battle of Hattin, the Christian authorities used the silver that covered the central shrine of the Anastasis to provide money for the troops. Saladin, however, soon captured the city but spared the Church, while forbidding pilgrimage. After the truce signed in 1229, Frederick II crowned himself in the Church. In 1244 an invasion by a Tartar tribe resulted in a massacre of Christians, and in damage to the Church. In 1335 three Greek monks were living in the Church and in 1345 the Franciscans were there established. The keys were held by the Moslems who controlled the entry of pilgrims and the applications of different ecclesiastical bodies to instal themselves in the church. In the year 1400 not only Greeks and Latins, but also Georgians, Armenians, Jacobites, Copts, and Abyssinians had holdings in the church. The processions of Palm Sunday and the ceremony of the Holy Fire were celebrated in common and the church was open to all the local Christians. Pilgrims like Jacques de Vérone removed as relics fragments of the Calvary Rock and other features.

Through the intervention of the Dukes of Burgundy the Latins enjoyed in the fifteenth century a privileged position, especially in regard to the edicule containing the Sepulchre,

while the Greeks, the Georgians, the Jacobites and the Syrians were possessed of allotments. The Armenians, who had lost Calvary to the Georgians, obtained by purchase a part of the tribunes of the Rotunda. In 1545 the Bell-Tower suffered from an earthquake. The fall of its cupola destroyed the dome over the chapel where the Greeks had their Baptistery. In 1555 the edicule surrounding the Sepulchre gave place to a new construction, the character of which is known from the drawings of Bernardino Amico and of Quaresmius. In the last quarter of the sixteenth century the Latins were allowed to carry out repairs, and took a leading part in the celebration of the more important ceremonies; with them were grouped Maronites, Uniate Armenians, Syrians, and Ethiopians. During the seventeenth century the Greeks and the Armenians increased their holdings. In 1664 the Georgians were evicted owing to being too poor to pay the necessary dues; the same fate befell the Abyssinians in 1668. Had it not been for the intervention of the French Ambassador at Constantinople the Latins would have lost charge of the Sepulchre itself. In the beginning of the eighteenth century, though the Latins were in a rather better position than to-day the Sanctuaries of the Church were allocated among the different ecclesiastical bodies much as they are now.

The condition of the dome over the Anastasis had been recognized as unsatisfactory since the end of the seventeenth century. Its timber construction dated from the time of the Emperor Constantine Monomach, more than six centuries earlier. Rival claims to carry out the repairs now required delayed action till 1719 when it was arranged that the Greek Patriarch Chrysanthos should be allowed to reduce the height of the Bell Tower (the condition of which menaced the security of the neighbouring structures), and to repair certain parts of his holdings, and that the Latins, under a firman obtained by the French Ambassador at Constantinople, should attend to the reconstruction of the Dome of the Anastasis and also to other repairs, under the condition that 150 Turkish prisoners were

released. This arrangement gave rise to difficulties, and, when the preparations were made to carry it out, three hundred Moors, descended from the Moors of Granada, rose against the Friars Minor who, but for the intervention of the Governor of Jerusalem would have been massacred. The works were, however, completed under the protection of three hundred soldiers.

The timbers of the Dome were found to be badly decayed, so much so that it was considered little short of a miracle that collapse had not occurred. The reconstruction followed the lines of Constantine Monomach's dome. 132 beams of Belgian pine were used and covered by lead sheeting, while, at the summit, an opening to the sky was left, 30 feet in diameter and closed only by netting to prevent birds entering. This opening was insisted upon by the Turks. The former mosaics of the drum were removed during the course of repairing the latter. On the same occasion other mosaics were removed and their tesserae sold to pilgrims. The drum or sub-structure of the Dome over the Anastasis is described as having consisted at that time of eight columns of marble and ten piers that formed the upper gallery. The lower gallery consisted of fourteen great columns of marble and six piers of dressed stone, and, in addition, two great piers supporting the arch that divides the Rotunda from the Choir. Plastering replaced both the mosaics that had either fallen or had been removed, and also the marble linings removed by the Turks. The mosaics in that part of the Calvary Chapel that belonged to the Latins were repaired, while those in the northern half of the Chapel and in the Greek Choir disappeared under a coat of lime.

In 1728 the edicule over the Sepulchre was repaired.

During the night of 12th October 1808 a fire broke out in an Armenian Chapel situated in the southern part of the upper gallery of the Rotunda. The Dome of the Anastasis was destroyed, and much damage done to its marble floor and to the marble revetment of the edicule containing the Sepulchre; of the latter, however, neither the structure itself nor even its

wooden door inlaid with mother-of-pearl suffered any serious damage.

The stone vaults of the Transept of the Greek Choir, the drum of the Rotunda with its marble pillars, the stone dome over the crossing of the transept with the choir, and the upper part of the external masonry of the main transeptal entrance were all badly damaged.

Europe was at that time embarrassed by the Napoleonic Wars; and, in 1809, the Greeks obtained a firman from Sultan Mahmud II to repair the church. They entrusted the work to a certain Comnenos, an architect from Mytilene. The doors of the main entrance were replaced by new ones. The ancient steps of the apse were removed and the apse itself largely rebuilt. The medieval piers supporting the transeptal dome and the vaults of the choir were obscured by the erection of walls between the piers, the original low walls between these piers having been removed. The lower part of the columns of the Rotunda were concealed by a stone-faced podium and their upper parts under rubble set in plaster thus forming the existing rectangular piers, while the ambulatory of the Rotunda was blocked by the construction of stores at floor level. A new edicule over the Sepulchre was built, a new Stone of Unction laid down, and the tombs of the Latin Kings destroyed.

The state of the church after the fire of 1808 must have been alarming. Many stones in the vaults threatened to fall and were kept in position by means of sheet lead and wedges of iron.

The columns of the Rotunda being badly calcined, their envelopment with rubble set in plaster already referred to was hastily carried out. The two walls which abut, at their eastern and western ends, the medieval piers that carry the stone Crusader dome both disfigured and consolidated the structure. The medieval piers suffered from deflexions due to loads and arch pressures normal in a building of this sort. This weakness had been aggravated by the effects of fire upon the masonry and also by successive earthquake shocks.

The three arches erected under the Triumphal Arch and the stone-built Iconastasis had similarly disfigured the church while consolidating it structurally in a north to south direction.

It should be noted that modern methods of consolidating masonry by grouting and reinforcement were not then known. There can be little doubt that the additions were in many cases prompted by fear of immediate collapse.

Since the earthquake of 1927 cracks have appeared between the walls above referred to and the piers they abut.

A new dome over the Rotunda was also constructed, but, after a life of about fifty years, showed signs of approaching collapse. Reconstruction was begun in 1863 and finished in 1868 at the joint expense of France, Russia, and Turkey.

After the earthquake of 1927 it was found necessary to demolish the stone dome of the twelfth century over the crossing of choir and transept. In the course of the reconstruction work it became apparent that the general condition of the whole church was so questionable that the completion of the new dome was suspended, and Mr. William Harvey, well known for his knowledge of, and experience in, conservation work was nominated by the British Government to carry out an analytical survey for the purpose of diagnosing the structural weaknesses from which the church is suffering and of making recommendations. The following report contains the results of his work.

E. T. RICHMOND.
Director, Department of Antiquities.

JERUSALEM,
15th June, 1935

NOTE. For further information readers are referred to *Jérusalem, Recherches de Topographie, d'Archéologie et d'Histoire.* Tome Second, *Jérusalem Nouvelle,* par les PP. Hugues Vincent et F.-M. Abel des Frères Prêcheurs. Librairie Victor Lecoffre; J. Gabalda, Éditeur, Rue Bonaparte, 90. Paris. 1914.

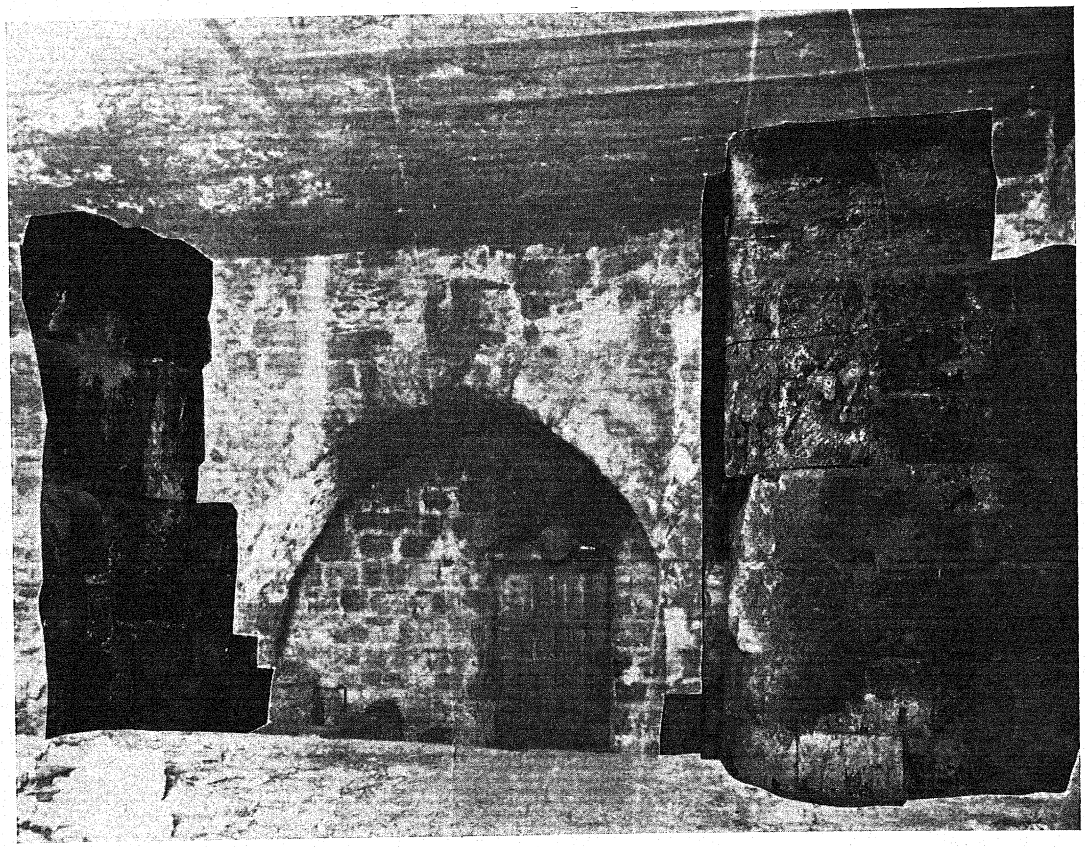

FIG. A. REMAINS OF CONSTANTINIAN ENTRANCE

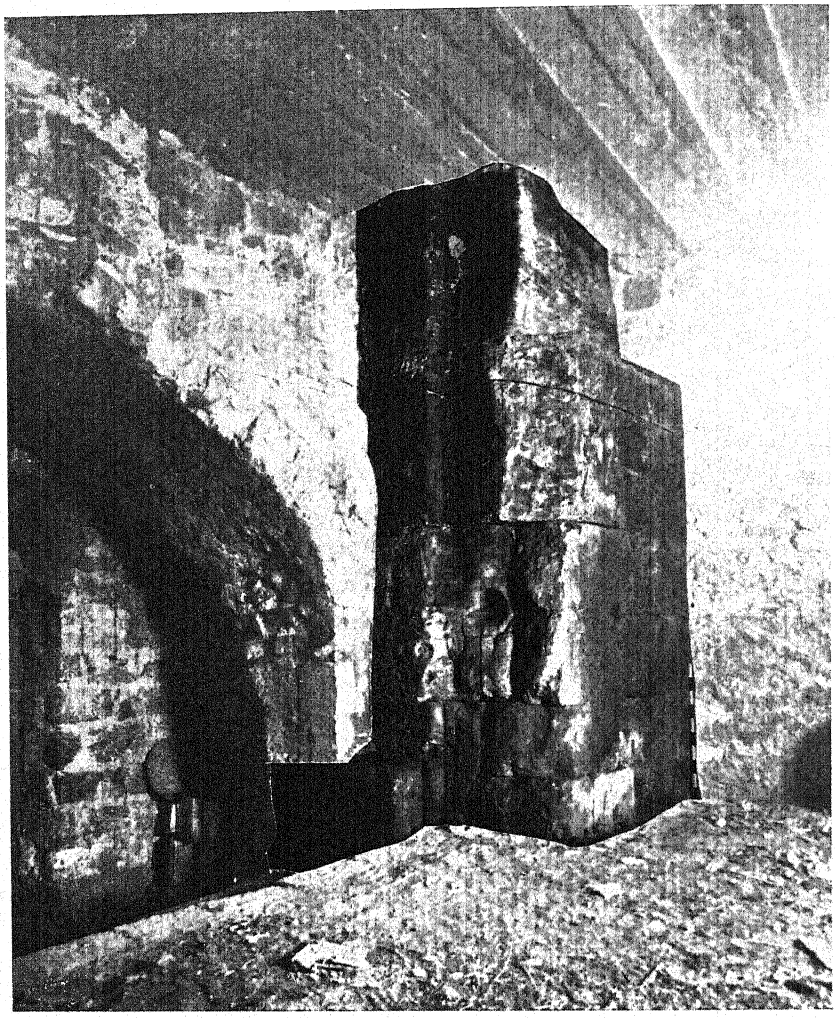

FIG. B. SOUTHERN PIER OF CONSTANTINIAN ENTRANCE

SYNOPSIS OF CONTENTS

THIS Report is divided into three parts: the first describing the present structural state of the Church, and the causes of decay. The second describes the measures of permanent repair necessary for its conservation. The third enumerates certain alterations which seem desirable on archaeological, or in certain instances on utilitarian grounds; though in most cases these last are independent of the scheme of repair, certain of them would have to be decided on before the structural work is carried out.

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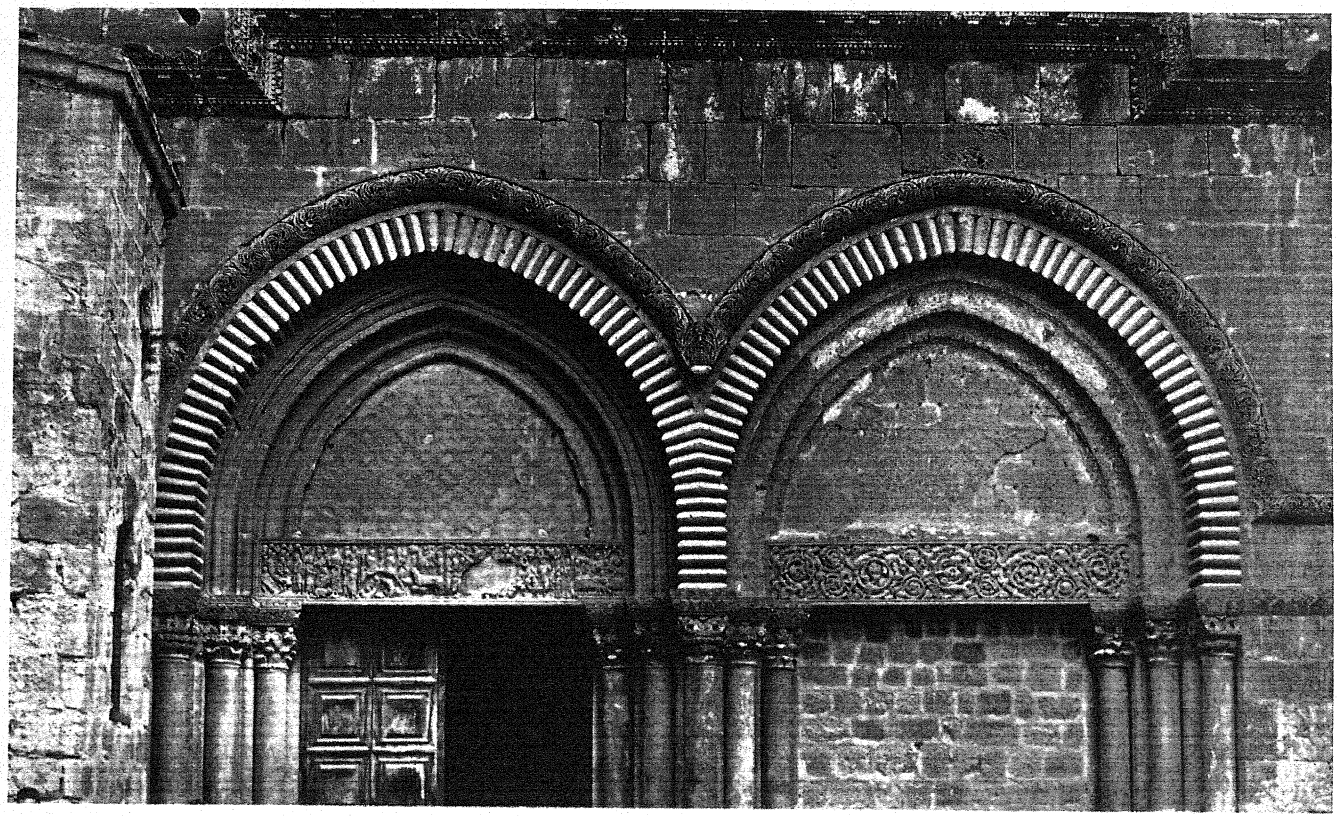


(Photo by kind permission of Mr. C. Raad)

MAIN FRONT, SHOWING CARVED PANELS OVER DOORWAYS, NOW REMOVED

Frontispiece to Report

PART I

THE PRESENT STATE OF THE FABRIC AND THE CAUSES OF DECAY

In order to describe clearly how the building has come to its present dangerous state, it is necessary first to enumerate the main causes of decay, and further to follow out their effects. The prime causes will be dealt with in order of importance: it should be noted that there seems to be no question of faulty foundations, as the solid rock is very close to the present ground-floor levels of all parts of the structure.

The causes of movement are therefore inherent in the building itself: the part played by recurrent earthquakes has been one of intensification of the initial damage originating in the internal stresses; weather conditions have been responsible also for a similar adverse effect, though to a less degree.

In addition, most of the Church was affected by the fire of 1808, which calcined much of the masonry, certain portions of which only were restored or rebuilt as a result. Almost all those portions built in the twelfth century suffer to a greater or less extent from the poor quality of the mortar used—it has in places completely disappeared, allowing the stones to sink, and deep cavities to appear.

A further source of weakness is that no true buttresses were employed here in the twelfth century, and very few of the arches are adequately restrained by tie-bars.

Proceeding to the main causes of the movements, these are: in the first place the weight and thrusts derived from the dome and drum over the Katholikon (see Figs. I, 2 and II, 1); and secondly those of the roof of the Rotunda (see Fig. II, 7), until 1808 a wooden cone—then replaced by a dome, since renewed, in 1867, with one of iron, resting on a new masonry drum.

I. KATHOLIKON DOME—SPHERE OF INFLUENCE

1. Pendentives and main piers.
2. Adjacent vaults and arcades.
   (*a*) North Transept.
   (*b*) Eastern arm and apse.
   (*c*) South Transept.
   (*d*) Rotunda.
3. Surrounding portions of the building.
   (*a*) Franciscan convent.
   (*b*) Eastern ambulatory.
   (*c*) Calvary and adjoining rooms.
   (*d*) Tower.
   (*e*) Chapels south of Tower.

II. ROTUNDA ROOF—SPHERE OF INFLUENCE

1. Main piers.
2. Rotunda Galleries.
3. Adjacent portions of the building.
   (*a*) North.
   (*b*) South.
   (*c*) West.

I. RESULTS OF THE WEIGHT AND THRUSTS OF THE DOME OVER THE KATHOLIKON

Situated above the centre of the whole Church group, the dome over the Katholikon has by its weight exerted considerable pressure on all its surroundings.

In considering this it is now necessary to assume that the dome (Fig. II, 1) and its supporting drum have acted as one unit; owing to weakness engendered by age, fire, and the unsafe central loading of the great chandelier, the dome was so badly affected by the earthquake of 1927 that its removal was necessary, and in consequence the drum has been consolidated and a new dome, with steel reinforcement, is in course of construction.

There is no appreciable deviation in the drum from a true circular plan; it may, therefore, be presumed that the pressure has been equally distributed in all directions, and that the differences in the observed decay are due to a varying capability as buttressing masses of these parts of the building.

The thrust is first communicated in a direction both downward and outward to the pendentives (see Figs. 1, 2, II, 24) supported on the four great arches of the crossing. It is to the position of the dome above the pendentives that the outward thrusts must be ascribed (see Fig. II).

1. PENDENTIVES AND MAIN PIERS

The pendentives (see Figs. 1, 2, II, 24) receive the weight of the dome and transmit it to the four main piers below, but there is also considerable outward thrust, as the pendentives are not vertical, but inclined inwards to the bottom of the drum above. They were completely plastered over after the fire of 1808, and do not themselves show signs of great movement, except in the North-west pendentive, which is badly cracked. The piers below have decided leans outwards in the upper portions, and from this inclination the further parts of the building have received the damaging thrusts (see Additional Notes, p. 14).

2. ADJACENT VAULTS AND ARCADES

(*a*) NORTH TRANSEPT

The North Transept proper consists of only one bay, with a vault above the main springing level of the great arches, and consequently occupying the same vertical space as the pendentives of the dome (see Figs. 3, I, 3). To the north of this bay is a gallery with two floors (see Fig. II, 9)—both originally of Byzantine construction; the lower vault (see Fig. 4) being below the Triforium arcades of the Transept proper. The upper vault (see Fig. 5) is above the Triforium, while leaving a clerestory lighting the high vault of the Transept above (see Fig. 6). This higher vault of the gallery is therefore in a position to receive

the full thrust of the springing of the high vault (see Fig. 3) which it communicates to the North wall of the gallery, here an exterior wall of the Church. This wall contains the most dangerous evidence of movement in the building (see Fig. IV). For the lower half of its height, its outward inclination is approximately 1 in 60, but above this, for three metres below the sills of a series of windows lighting the upper gallery, it becomes rapidly sharper, reaching 1 in 20 and even 1 in 16. This is the more serious in that this upper walling contains work of several periods, ill bonded together, and much of the mortar has disappeared (see Fig. 7).

Several instances occur of wide open joints penetrating through more than half the thickness of the wall, while the inner courses of voussoirs to the window arches have fallen downwards, leaving a wide space below the higher masonry (see Fig. 8). As the wall is restrained at each end by other buildings, leaving less than thirteen metres free to move outwards, such a grave inclination in the centre has resulted in great curvature of the wall-top (see Fig. 9) and this, together with the overhang and poor state of the mortar joints, may at any time allow the fall of some of the facing stones—should this occur any attempt to save the rest of the wall would be extremely dangerous, and collapse of the high vaults behind might easily follow.

During plastering which took place eighteen months ago, it was found that the vault of the upper gallery was not in contact with the outer wall in many places (see Fig. 10); the very large cracks then visible are now hidden by the new plaster, but within the last few months the plasterwork has again shown cracks in the same positions as the hidden defects, thus indicating that movement is now continuing. The carved stone capitals of the attached half-columns supporting this vault are badly cracked owing to the pressure and torsion to which they are subjected.

As this gallery was built before the existence of the present Church to the south, its southern, inner, arcade and walling lean inwards in response to its vault-thrusts, and communicate

to the arcade of the North Transept high vault an inward tendency in the middle of its height and giving to its inclination a double form, inwards at the bottom, then outwards higher up.

The high vault itself (see Fig. 11) has also been plastered, but some two years ago a large stone fell from one of the main ribs, and the upper walls, where accessible from outside, are in an extremely poor condition (see Figs 12, 13, 14), many joints being completely denuded of mortar, and much of the masonry cracked and suffering from erosion, and to some extent from the effects of the fire of 1808.

The marble columns of the Byzantine arcade (see Fig. 15) are seriously cracked as a result of the thrusts, and of the great weight resting upon them. The cracks appear to be recent, and loose splinters of the marble can be detached.

(*b*) EASTERN ARM AND APSE

The Eastern arm of the Church dates from the twelfth century, but the work is obscured by the plastering and additions of 1810 (see Figs. 16, 17, I, 5–II, 2). The apse (see Figs. I, 6–II, 3) is divided into two stories, of which the lower probably retains a twelfth-century core, while the upper is completely of the 1810 rebuilding. While the lower work remains upright, owing to the buttressing effect of many low vaults entirely surrounding it, the upper work is in a bad state of disrepair (see Fig. 18).

The thrust from the dome reveals itself in the outward lean of the walls, though this is restrained to some extent by iron tie-bars which encircle the apse at several levels. These are, however, quite insufficient to maintain the walls with safety, and have caused considerable dislocation of the masonry due to rust. Large numbers of iron cramps were also used in the jointing of the stone with disastrous effects, as hardly any of the stones remain unfractured.

Near the apse roof, the bed-joints of several courses are devoid of mortar (see Fig. 19), and the parapet, unrestrained by any tie-bars, has moved outwards (see Fig. 20).

(*c*) SOUTH TRANSEPT

The South Transept (see Figs. I, 1–II, 2), including the main front of the Church, contains much twelfth-century work; but the interior suffered greatly from the fire, and was partly rebuilt (see Figs. 21, 22, 23). The South wall shows very considerable calcining of the masonry, principally in the upper story, and a large proportion of the stonework is unfit to support the superincumbent weight and thrusts.

Owing to the great arches of the lower story resting on splayed piers with colonnettes (see Fig. III), the wall is greatly overloaded on its outer face; an overturning moment is thereby set up in addition to the dome thrusts. The whole length of the wall has an outward inclination, slight next to the Tower, but increasing rapidly to a point rather to the east of the central pier, and then slightly reduced at the south-eastern corner (see Fig. III).

The lower colonnettes and their bases are almost all cracked, the oblique direction of the cracks showing the asymmetrical loading of the arches above (see Fig. 24). The condition of most of the carved work is extremely good (see Figs. 25, 26, 27, 28, 29) with the exception of the inner orders of the upper arches, which suffered most from the fire (see Figs. 30, 31, 32).

The main cornice at the wall top is greatly dislocated (see Figs. 33, 34) and harm has been done by the insertion of iron wedges and cramps which have caused cracking, due to rust (see Fig. 35).

Serious cracks occur both from the outside of the wall (see Fig. 36) and in the attached pier within (see Fig. 37); while others between the vault and the wall have been covered by plaster (see Fig. 38) (see also Additional Notes, pp. 13 and 15).

(*d*) ROTUNDA

The Rotunda (see Fig. I, 13) is only slightly affected by the thrust from the Katholikon dome, as it has proved a sufficient buttressing mass.

3. SURROUNDING PORTIONS OF THE BUILDING

(*a*) FRANCISCAN CONVENT

Immediately to the north of the main Church, and stretching westwards, is the Convent of the Franciscans, (see Fig. I, 16), including the Chapel of the Apparition (see Fig. I, 14).

Much of the buildings, including the walls of the Chapel, date from the Byzantine period, and are of massive construction. Owing to this and to the fact that they are themselves abutted by further structures to the north, there seems to be no serious decay. The South wall of the Latin Sacristy forms the outer wall of the Byzantine gallery, and is subject to considerable pressure.

As it is not of great thickness and has been weakened by the formation of extensive cupboards, it is in need of some reinforcement.

(*b*) EASTERN AMBULATORY

The Eastern ambulatory (see Fig. 39, I, 7) surrounds the lower part of the apse, and from it open three apsidal chapels, and four openings; the stair to St. Helena's Chapel, the old doorway to the Cloister, the passage to the present Greek Refectory, and a small chamber in the thickness of the North wall (see Fig. I, 8, 9, 10, 30).

The transverse walls of these chambers act as buttresses, and as they are in most cases surrounded by more distant vaults, the outer wall of the ambulatory remains upright. There are few signs of decay except for some very slight cracks.

This wall is of the twelfth century, and contains some excellent carved capitals (see Figs. 40, 41) and impost mouldings which have been damaged by the restoration of 1810 (see Fig. 42).

In one case a capital seems to have been struck violently, and much of its foliation detached, at a very recent period (see Fig. 43).

The Chapel of St. Helena (see Figs. 44, I, 28) lies below ground-level (see Fig. 45) and there is consequently but slight

decay of structural consequence. The dome (see Fig. 46) leaks and requires water-proofing outside, as the rough-cast stucco has become badly cracked (see Fig. 47). The floor is in a bad state, also the flight of steps leading to the Grotto of the Invention (see Fig. 48); these are at present covered with iron gratings.

The Grotto (see Fig. I, 29) itself is in part natural and partly rock-hewn, and consequently does not suffer from structural decay.

(*c*). CALVARY AND ADJOINING ROOMS

The Calvary chapels (see Fig. I, 42, 43) occupy the upper half of the lower story of the main front in position but are to the east (see Fig. I). They are of twelfth-century workmanship, though much altered by the restorations of 1810 (see Fig. 49). The original entrance through the porch to the east of the main entrance arches (see Figs. 50, I, 44) (now the Chapel of Our Lady of the Seven Sorrows) has been blocked up, but a grated window still remains. At this point there is a considerable outward lean towards the south, though this becomes less in the upper part of the wall above the chapels. The vaults are cracked as also are those of the upper rooms which fill the space above, beneath the main roof.

The one-time porch, supported at its South-west angle by a slender pier, is badly damaged by the thrusts of its own small cupola, aided by the outward lean of the South wall behind. These thrusts have for many years been met by an unsightly series of iron bands around the exterior.

Much carving dating from the twelfth century is found here (see Fig. 51), both on the exterior and inside. While that executed in stone has weathered well on the whole, though damaged by vegetation, some of the work in marble has suffered similar decay to the panels which were removed from above the main doorways.

There appears to be plaster of Paris in close contact with these decayed areas.

Further to the south-east, and at the top of the building (see Fig. 52), is the Chapel of Melchizedek (see Figs. 53, 54, II, 12). As it is buttressed by the buildings of the Greek Convent of Abraham, it has only partially suffered from the dome thrusts. The North wall of the old Refectory (see Fig. 55) (of the Latin Priory of the Crusaders) (see Fig. II, 14) is extremely thick, and has controlled the movement of this South-eastern angle of the building.

(*d* and *e*) TOWER AND CHAPELS TO THE SOUTH

The Tower (see Figs. 56, II, 6) which was built in the twelfth century, but at a later period than the main front, is based upon an earlier Byzantine chapel, dedicated to the Forty Martyrs (see Fig. I, 31). Notwithstanding the great buttress-masses carried down to ground-level, the whole height of the Tower leans away from the thrusts radiating from the dome, and in the upper free-standing stories shows signs of grave decay. The Tower has recently been surrounded with three iron bands but these are quite inadequate to ensure its safety (see Fig. 57) Both South and West walls are inclined outwards, and there is a large fracture through the southern arch of the West wall above the Belfry story (see Fig. 57).

The upper stories of the Tower were removed about two centuries ago, having then become dangerous.

Previously the roof had collapsed to the south in the earthquake of 1545, and carried with it the dome of the old Baptistery (see Fig. 58).

The Baptistery (see Figs. I, 32–II, 19), now partly open to the sky and in part vaulted over at a low level (see Fig. 59), shows little sign of decay in itself, but the thrust communicated to it by the Tower has succeeded in forcing its South wall outwards against the thrust of the vault of the Chapel of St. James (see Figs. 60, I, 33).

This Chapel is in a state of grave danger, as the lower half of its South wall (see Figs. 61, 62) overhangs the adjoining street

by $22\frac{1}{2}$ centimetres, and the crown of the vault is cracked throughout its length (see Figs. 63, V).

II. ROTUNDA ROOF—SPHERE OF INFLUENCE

1. ROTUNDA PIERS

The piers of the main Rotunda (see Fig. I, 13) are now square (see Fig. 64), though they probably enclose as a core the earlier round columns of the building of Constantine Monomach (*c.* A.D. 1048). The present piers are clamped together with rusting iron (see Fig. 65), are very irregular in shape and size, and are not placed symmetrically beneath the circular drum built in 1867. They are therefore subject to eccentric loading, and all of them show cracks to a greater or less extent; some of these cracks are serious, though certainly due to earthquake shock as well as to thrusts (see Fig. 66).

2. ROTUNDA GALLERIES

The galleries of the Rotunda (see Fig. 67) surround the main piers, and are enclosed by a circular wall, whose lower portions date from Constantine's original Anastasis (see Fig. 68). This circular wall leans outwards owing to the thrusts of the gallery vaults and the communicated thrusts of the cone which covered the central space prior to 1808.

At the top the outward inclination is severe, and has affected the surrounding vaults and further walls (see Fig. 57).

3. ADJACENT PORTIONS OF THE BUILDING

(*a*) NORTH

The buildings adjacent to the Rotunda on the north are almost entirely comprised in the Franciscan Convent. They do not seem to have suffered from the thrusts of the Rotunda, as they contain massive transverse walls of Byzantine workmanship.

(*b*) SOUTH

The southern face of the outer Rotunda wall is abutted by the Great Convent of the Greeks up to within 4 metres of the wall top, but notwithstanding this buttress mass, the lower portions of the wall have an outward inclination.

Almost at the top is the small Chapel of St. Constantine (see Fig. II, 21); it is within this that the outer Rotunda wall shows its worst leans, which are also easily perceptible in the opposite South wall of the Chapel, which stands on the Convent roof (see Fig. 57). The condition of both walls at this level is serious, as large cracks in the surface stucco of the Chapel show.

(*c*) WEST

The buildings to the west of the Rotunda all form parts of the Crusader Patriarchate in Christian Street (see Figs. I, 21–II, 8). It is divided into bays by massive buttresses, and internally by transverse walls, which add considerably to the stability of this portion of the Church within. The upper portion is, however, cracked.

MISCELLANEOUS DECAY

Two further points, unconnected with the main decay, demand consideration.

The roofs in general are in a bad state, and allow much rainwater to penetrate to the interior. As previously mentioned this has led to much extra weight being imposed on the building as successive layers of roofing material have been laid (see Fig. 69).

Secondly, the major part of the South wall of the old Latin Refectory (see Figs. 70, 71, II, 14) is in a ruined state, with large masses of overhanging vaulting. These are cracking away from the wall, and there is grave danger of their collapse.

DANGER OF FIRE

In view of the disastrous fire of 1808, it seems desirable to point out that present conditions in the building could easily

produce another such conflagration. Many of the small rooms which have been formed in the aisle of the Rotunda (see Figs. 72, I, 23) are used as stores for miscellaneous property, including large quantities of candles and oil. As there is much dry and decaying timber adjacent, a fire could easily be started, especially as only open lamps and candles are used for light in these rooms.

As the remainder of the building also contains large quantities of dry timber, cloth, and other inflammable substances, steps should be taken to minimize the present danger, which appears to be considerable.

GENERAL CONCLUSIONS

The decay found in the structure during the survey is in the main due to the thrusts from the dome of the Katholikon, and also to a lesser extent from the old roof of the Rotunda. Contributing causes are the individual thrusts of the subsidiary vaults.

Owing to the nature of the fabric, which is mainly of Crusader period, *c.* 1140–80, these thrusts have been able to force outward all the exterior walls of the building, and in many cases the walls of subsidiary surrounding structures.

Apart from the absence of buttresses, special features which have rendered the decay easier are the poor mortar used, the comparative thinness of the main walls, and the small area of the building in proportion to its height. Earthquakes, which occur frequently, and of which there is a severe shock at least every century, and the disastrous fire of 1808 have also played a prominent part in accelerating the rate of decay, though the unbalanced thrusts of the building would in the end cause its downfall, even under more fortunate circumstances.

A special characteristic of the Church is its decorative carvings of the Byzantine and Crusader periods. Those on the exterior have suffered from weather, fire, plants, birds' nests, and chemical action, while in the interior much has been lost by 'restoration' and alterations, and careless use of plaster and limewash.

The floors of the whole Church, with the exception of the Katholikon, and some of the upper galleries, are in bad condition and need relaying.

The roofs have been from time to time thickened with new layers of material in order to keep out the weather; this has added unnecessary weight and further aids the decay.

The measures of consolidation required to put the building into a state of permanent safety will now be dealt with in Part II of the Report.

ADDITIONAL NOTES

The following further discoveries came to light on the 16th and 17th April in the course of a close inspection (made possible by a new scaffolding) regarding the condition of (*a*) the South Transept Vault; (*b*) the great arches under the Katholikon Dome.

As to (*a*): the plaster was found to be bulging in several places. In some of these places the causes of the bulge were investigated. The plaster was considerably cracked; some of these cracks were black and old, others white, sharp and obviously new.

On removal of the bulging plaster a number of copper nails with large heads of a diameter of about $3\frac{1}{2}$ centimetres were observed in the joints between the stones. The purpose of these nails was to provide a key to hold the plaster in place. These nails owing to the opening of the joints were no longer secure. The plaster work and the nails clearly date from the repairs executed in 1869. Pieces of sheet lead were found to have been inserted in the widened joints between the stones of the vault. These pieces of lead enclosed iron wedges inserted between stones badly cracked by the fire of 1808. The purpose of this work was to prevent the damaged vaulting stones from falling. The iron is now completely rusted and has ceased to act as wedges. In certain instances small pieces of the iron have amalgamated with the stone and have lost connexion with the main body of the iron wedge to which they originally belonged. The

condition of the stones was found to be very bad; the surfaces of the stone were reduced to dust by calcination in 1808. Further, the action of the fire had been to laminate the stones with the result that large pieces of them were ready to fall. Where examination has been made the pieces ready to fall weighed in some instances as much as 4 kilograms, others less, but most of sufficient weight to kill a man had they fallen. The insecurity of the vaulting was further evident when it was found possible to insert without difficulty a rod to a depth of, in one instance, 60 centimetres, in another 50 centimetres.

As to (*b*): the summits of two of the great arches carrying the Katholikon Dome were examined and found to be badly calcined, cracked, and heavily botched with plaster. The only portions which can, under present circumstances, be examined are those where cracks were observable in the plaster botching. As to the latter, a big piece weighing about 12 kilograms was found to be about to fall on the North Transept. Several smaller pieces had to be left *in situ* until a permanent centring can be built to retain the arches during the removal of the plaster.

The two arches that it has been possible so far partly to examine are the 'Triumphal Arch' (west) and the northern arch.

During my survey of the building I found sufficient evidence to prove that movements had occurred.

The following report shows that movement is still continuing.

1. Since the foregoing was written the Triumphal Arch between the Rotunda and the Katholikon Dome has become cracked.

The second or intermediate arch has dropped away from its original position and has a long open joint on its extrados.

The arch was badly calcined by the fire of 1808 and pieces of stone put in with plaster of Paris, during former repairs, have now fallen away.

It was found necessary immediately to fill in the joints with Portland Cement mortar.

2. The Crusader column in the North Transept has also become cracked; the crack is due to the eccentric loading of the piers and arches in the upper story, aggravated by local movements which are related to the general tendency of the structure to spread. This column has been wrapped around with steel bands as a temporary measure of repair.

The Byzantine column adjoining it has also cracked and has been treated in a similar manner.

3. The Eastern vault of the Armenian holding over the South Transeptal entrance has cracked. Tell-tales have been put in position.

4. Of the Tell-tales placed on the South front of the building, the one on the eastern pier by the South-east window, first floor, cracked about seven days after the cement had set.

5. Another Tell-tale placed on the High vault of the eastern arm, abutting the apse, also cracked about nine days after the cement had set.

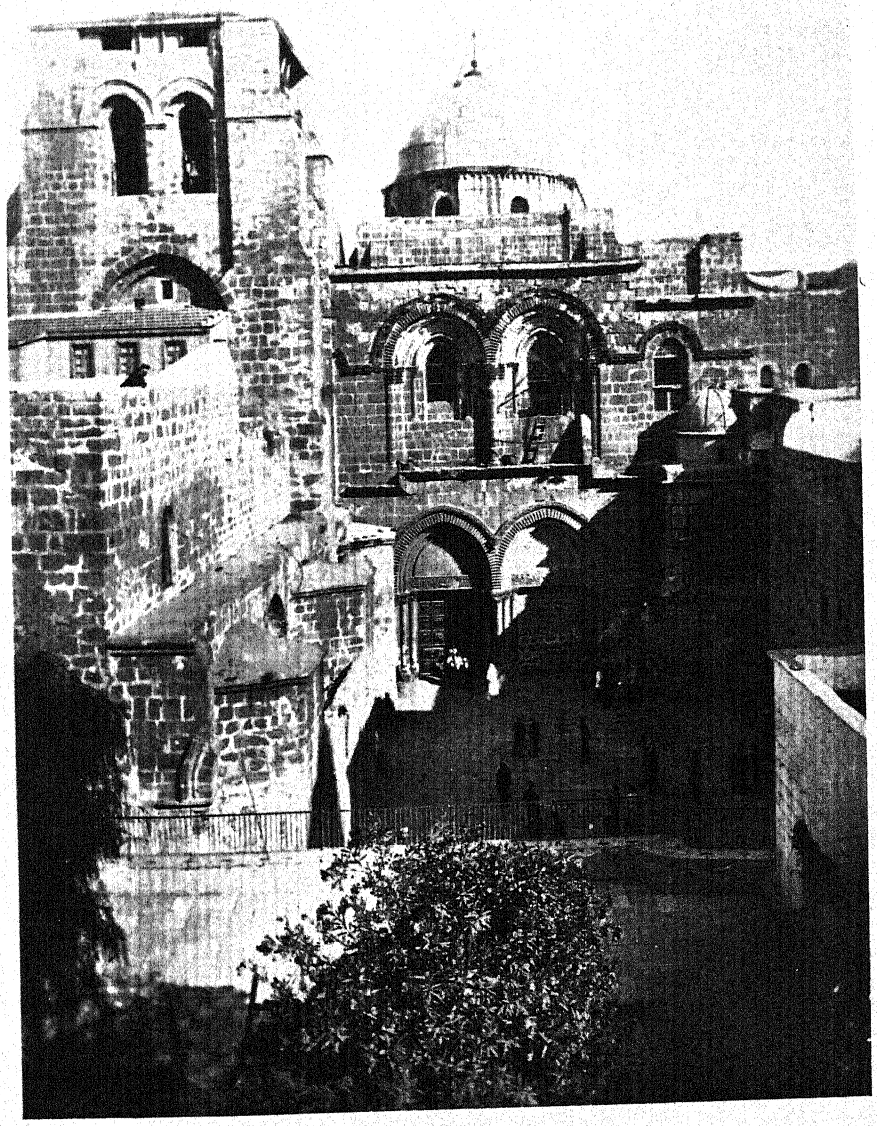


FIG. C. MAIN SOUTH FRONT

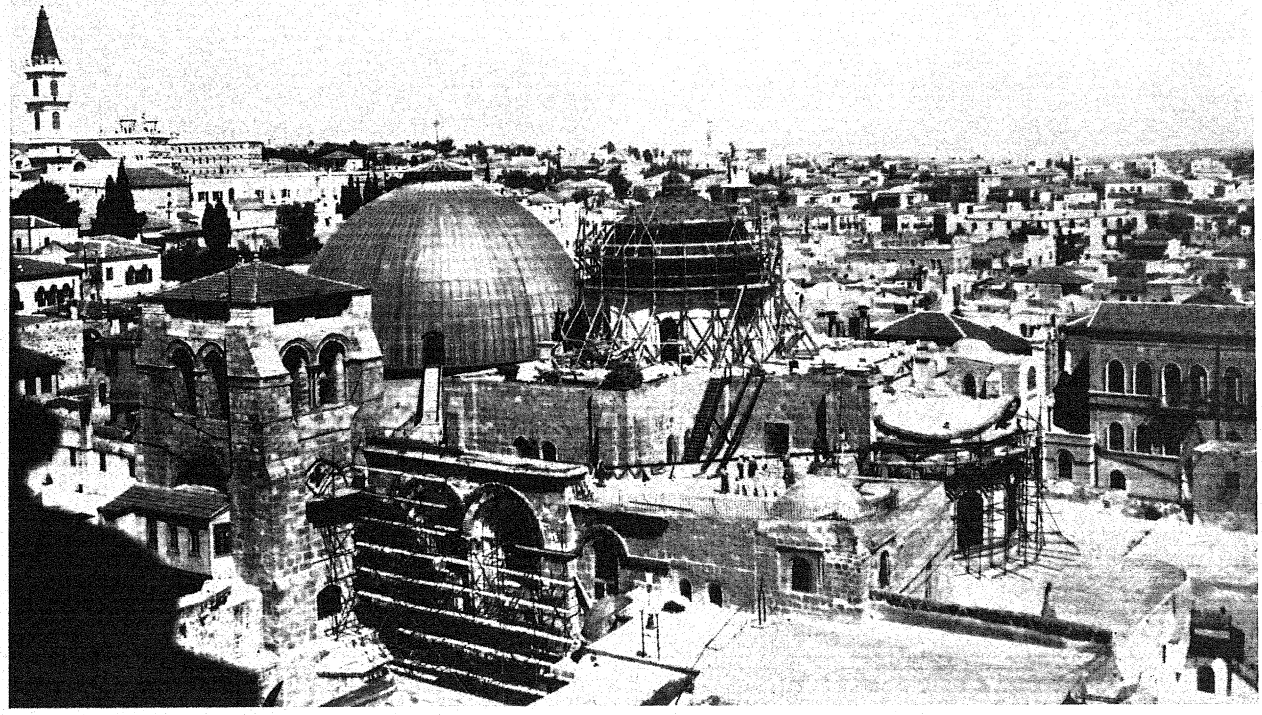


FIG. D. VIEW FROM SOUTH-EAST (TOWER OF LUTHERAN CHURCH)

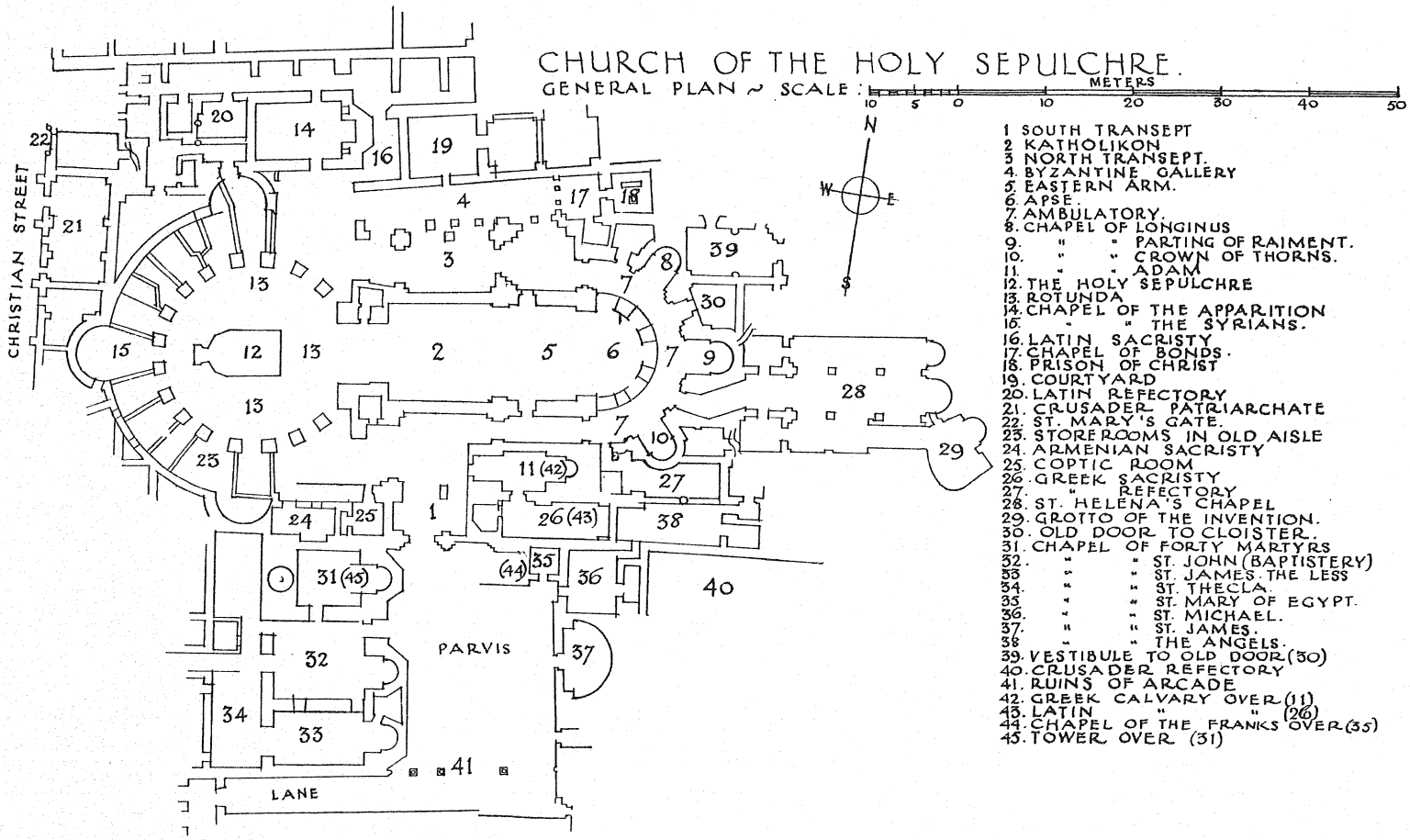

CHURCH OF THE HOLY SEPULCHRE.
GENERAL PLAN ~ SCALE :
METERS
10 5 0 10 20 30 40 50
N
W E
S
CHRISTIAN STREET
PARVIS
LANE
1 SOUTH TRANSEPT
2 KATHOLIKON
3 NORTH TRANSEPT.
4 BYZANTINE GALLERY
5 EASTERN ARM.
6 APSE.
7 AMBULATORY.
8 CHAPEL OF LONGINUS
9 " " PARTING OF RAIMENT.
10 " " CROWN OF THORNS.
11 " " ADAM
12 THE HOLY SEPULCHRE
13 ROTUNDA
14 CHAPEL OF THE APPARITION
16 " " THE SYRIANS.
16 LATIN SACRISTY
17 CHAPEL OF BONDS.
18 PRISON OF CHRIST
19 COURTYARD
20 LATIN REFECTORY
21 CRUSADER PATRIARCHATE
22 ST. MARY'S GATE.
23 STOREROOMS IN OLD AISLE
24 ARMENIAN SACRISTY
25 COPTIC ROOM
26 GREEK SACRISTY
27 " REFECTORY
28 ST. HELENA'S CHAPEL
29 GROTTO OF THE INVENTION.
30 OLD DOOR TO CLOISTER.
31 CHAPEL OF FORTY MARTYRS
32 " " " ST. JOHN (BAPTISTERY)
33 " " " ST. JAMES THE LESS
34 " " " ST. THECLA.
35 " " " ST. MARY OF EGYPT.
36 " " " ST. MICHAEL.
37 " " " ST. JAMES.
38 " " " THE ANGELS.
39 VESTIBULE TO OLD DOOR (30)
40 CRUSADER REFECTORY
41 RUINS OF ARCADE
42 GREEK CALVARY OVER (11)
43 LATIN " " (26)
44 CHAPEL OF THE FRANKS OVER (35)
45 TOWER OVER (31)

FIG 1

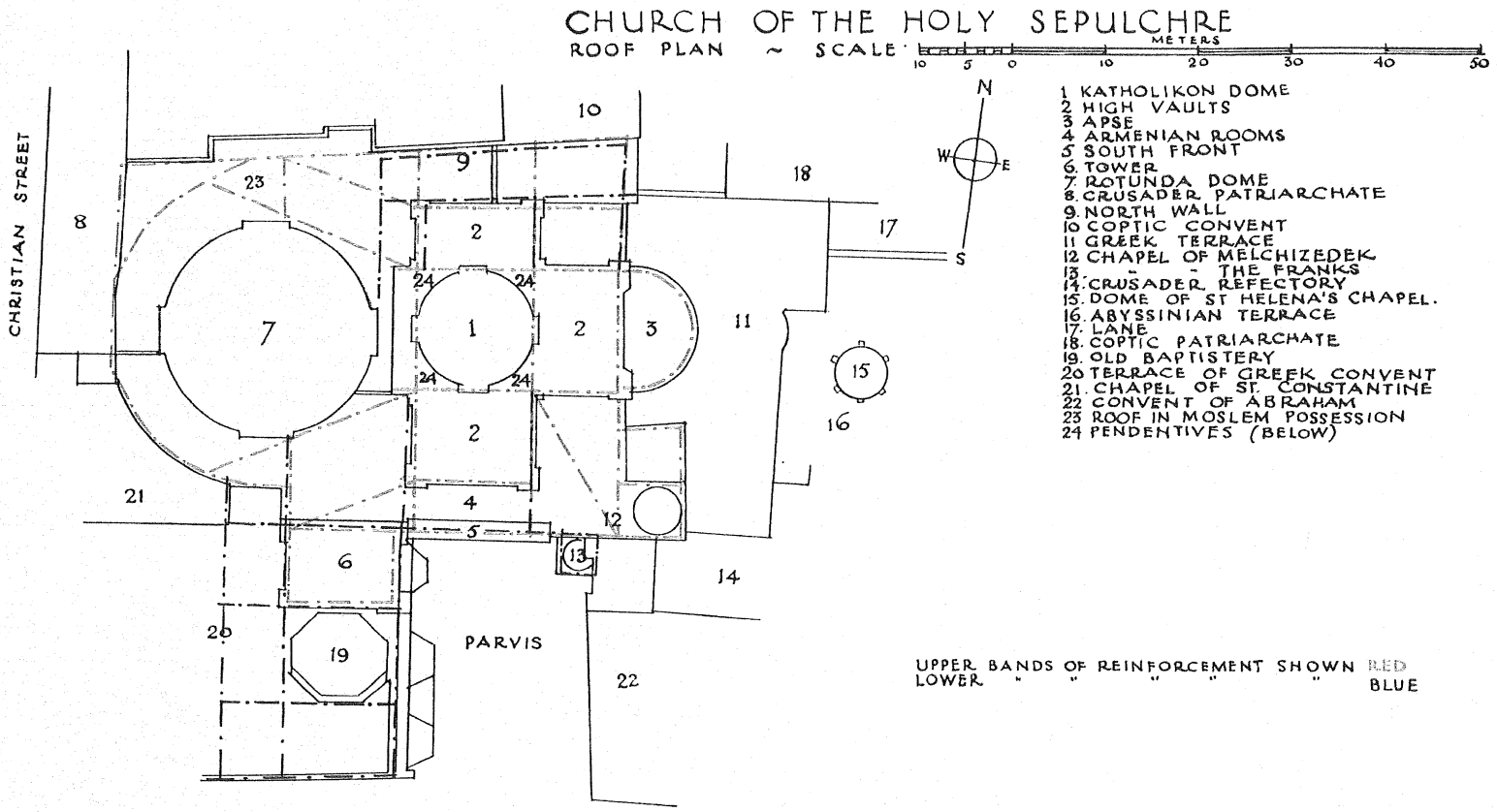

CHURCH OF THE HOLY SEPULCHRE
ROOF PLAN ~ SCALE
METERS
10 5 0 10 20 30 40 50
N
W
E
S
1 KATHOLIKON DOME
2 HIGH VAULTS
3 APSE
4 ARMENIAN ROOMS
5 SOUTH FRONT
6 TOWER
7 ROTUNDA DOME
8 CRUSADER PATRIARCHATE
9 NORTH WALL
10 COPTIC CONVENT
11 GREEK TERRACE
12 CHAPEL OF MELCHIZEDEK
13 " " THE FRANKS
14 CRUSADER REFECTORY
15 DOME OF ST HELENA'S CHAPEL.
16 ABYSSINIAN TERRACE
17 LANE
18 COPTIC PATRIARCHATE
19 OLD BAPTISTERY
20 TERRACE OF GREEK CONVENT
21 CHAPEL OF ST CONSTANTINE
22 CONVENT OF ABRAHAM
23 ROOF IN MOSLEM POSSESSION
24 PENDENTIVES (BELOW)
CHRISTIAN STREET
PARVIS
UPPER BANDS OF REINFORCEMENT SHOWN RED
LOWER " " " " " BLUE

FIG. II

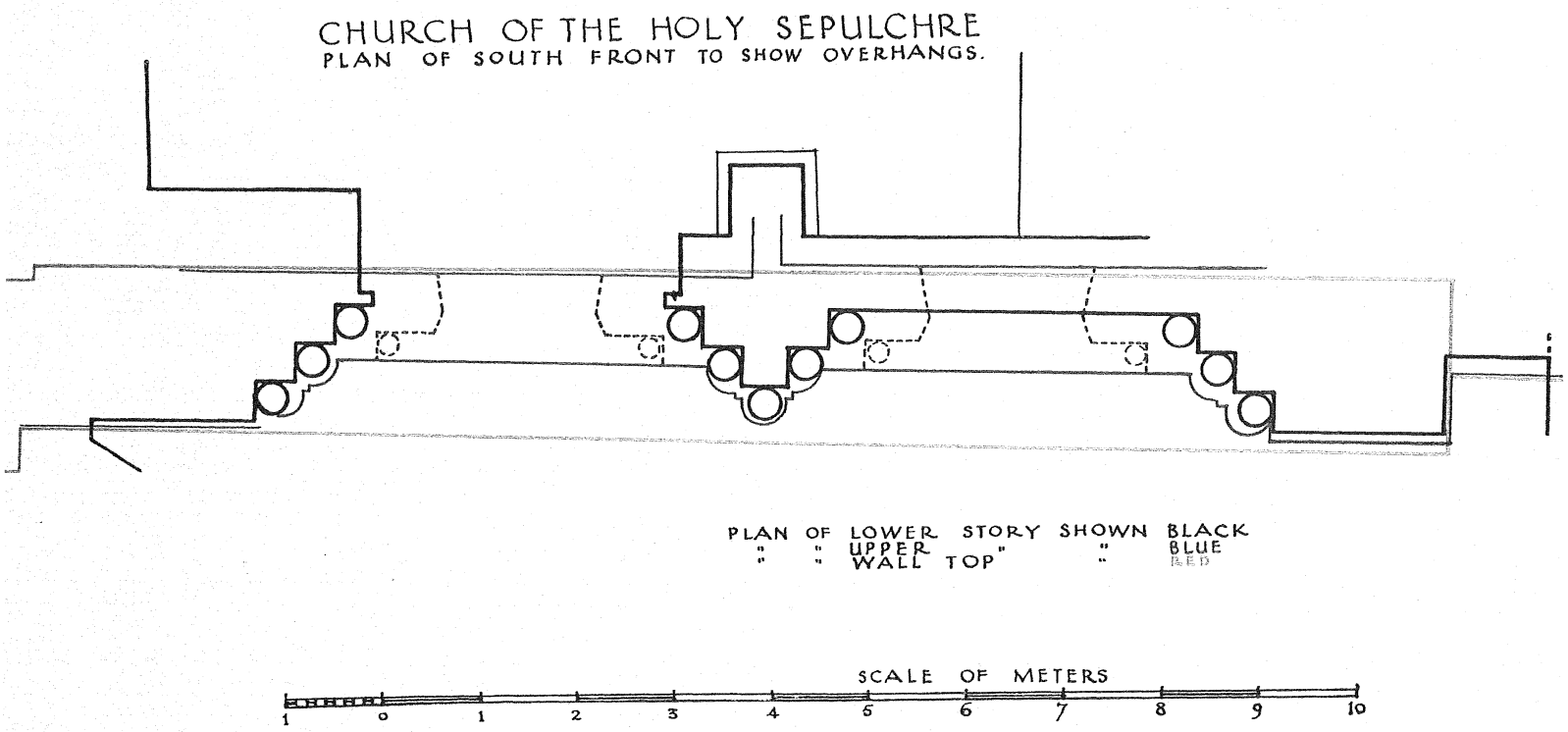
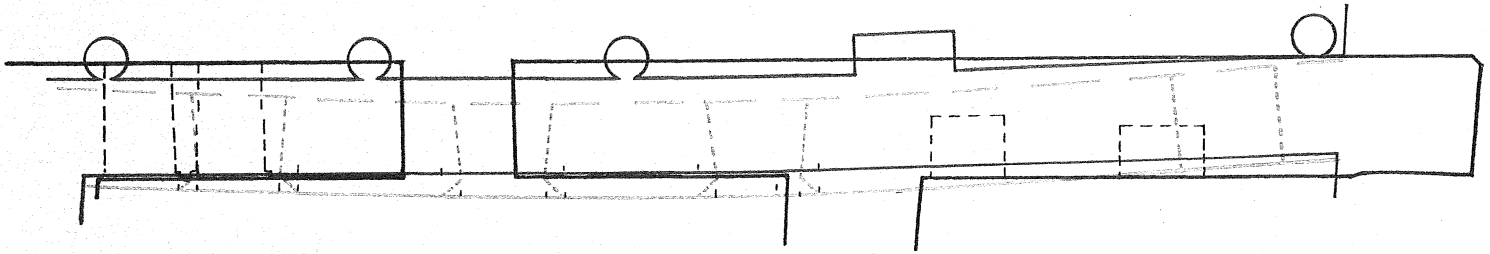

CHURCH OF THE HOLY SEPULCHRE
PLAN OF SOUTH FRONT TO SHOW OVERHANGS.
PLAN OF LOWER STORY SHOWN BLACK
" " UPPER " " BLUE
" " WALL TOP " " RED
SCALE OF METERS
1 0 1 2 3 4 5 6 7 8 9 10

FIG. III

CHURCH OF THE HOLY SEPULCHRE

PLAN OF NORTH WALL TO SHOW OVERHANGS.



PLAN OF LOWER STORY SHOWN BLACK
" " UPPER " " BLUE
" " WALL TOP " " RED

FIG. IV

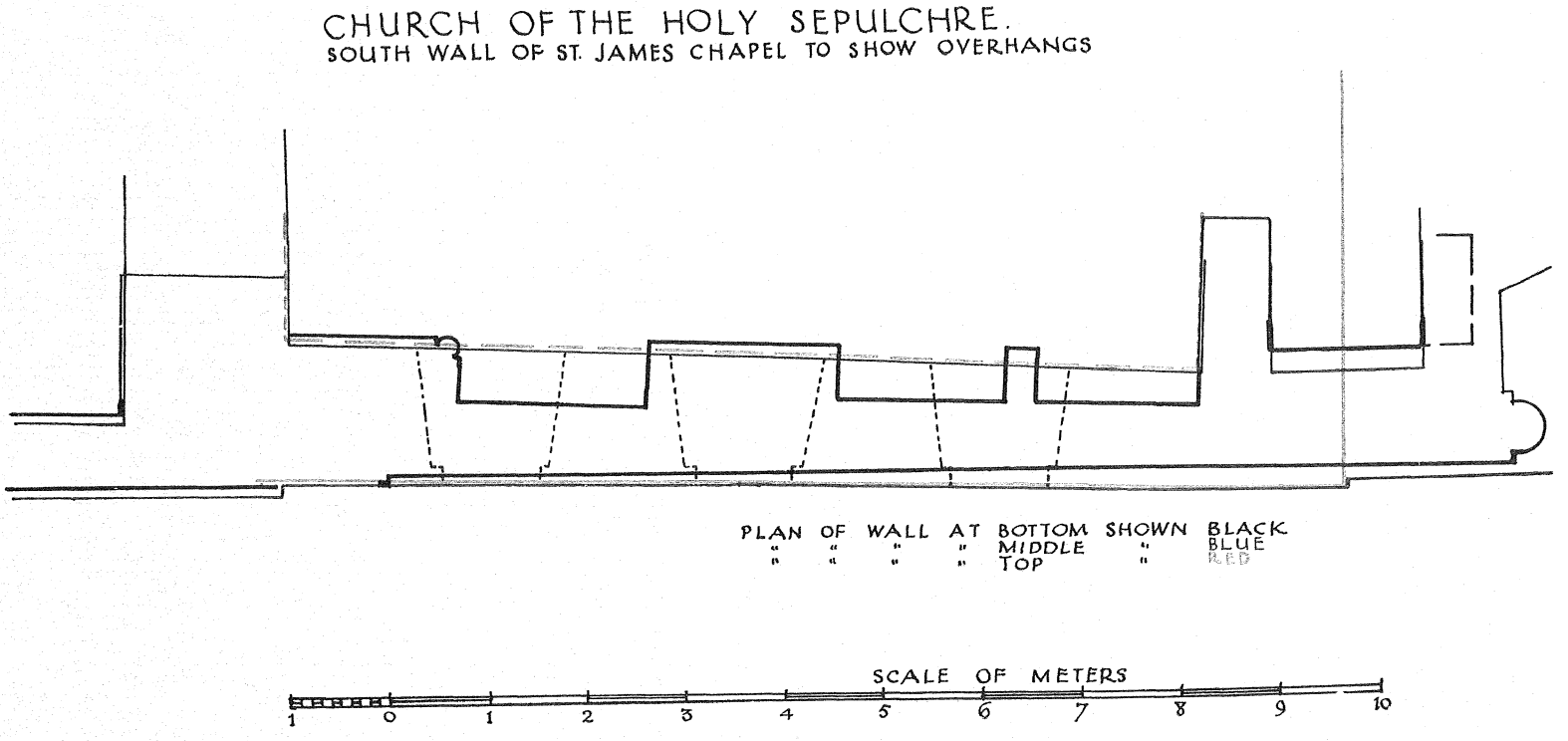

CHURCH OF THE HOLY SEPULCHRE.
SOUTH WALL OF ST. JAMES CHAPEL TO SHOW OVERHANGS
PLAN OF WALL AT BOTTOM SHOWN BLACK
" " " " MIDDLE " BLUE
" " " " TOP " RED
SCALE OF METERS
1 0 1 2 3 4 5 6 7 8 9 10

FIG. V

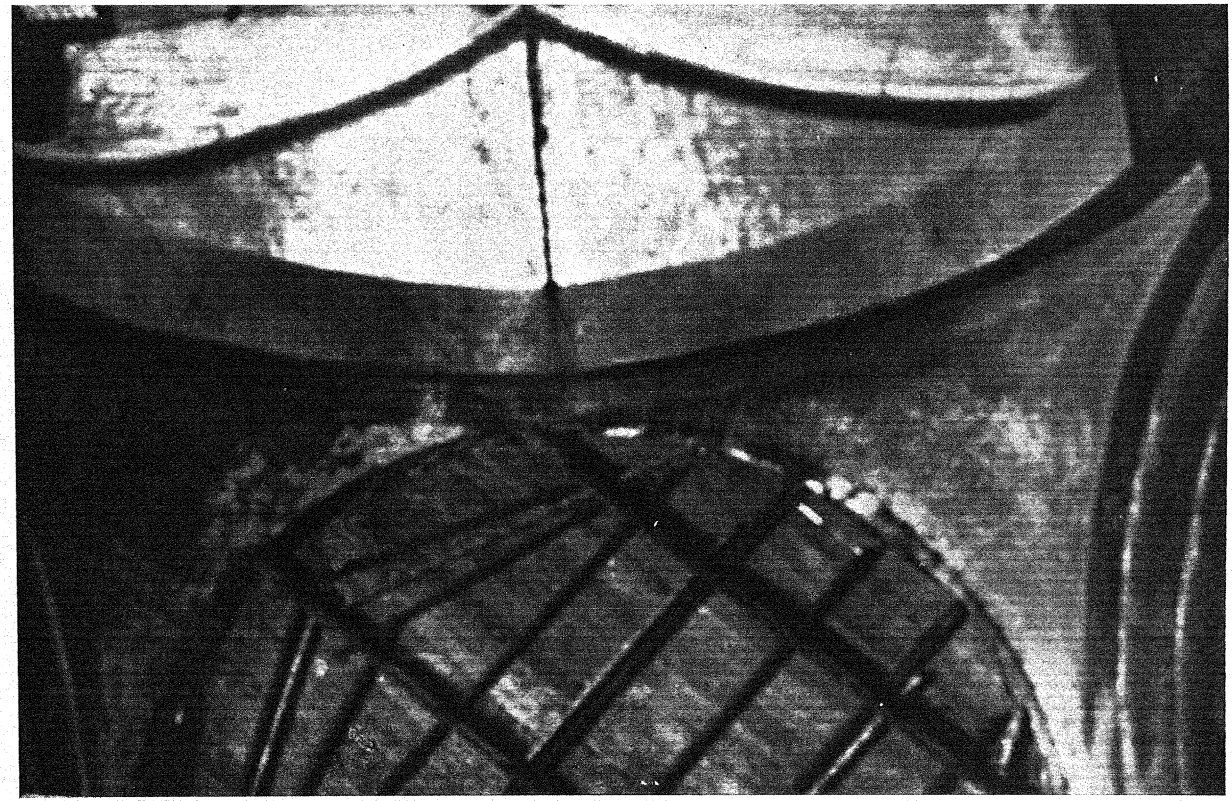


FIG. 1. EASTERN PENDENTIVES FROM BENEATH

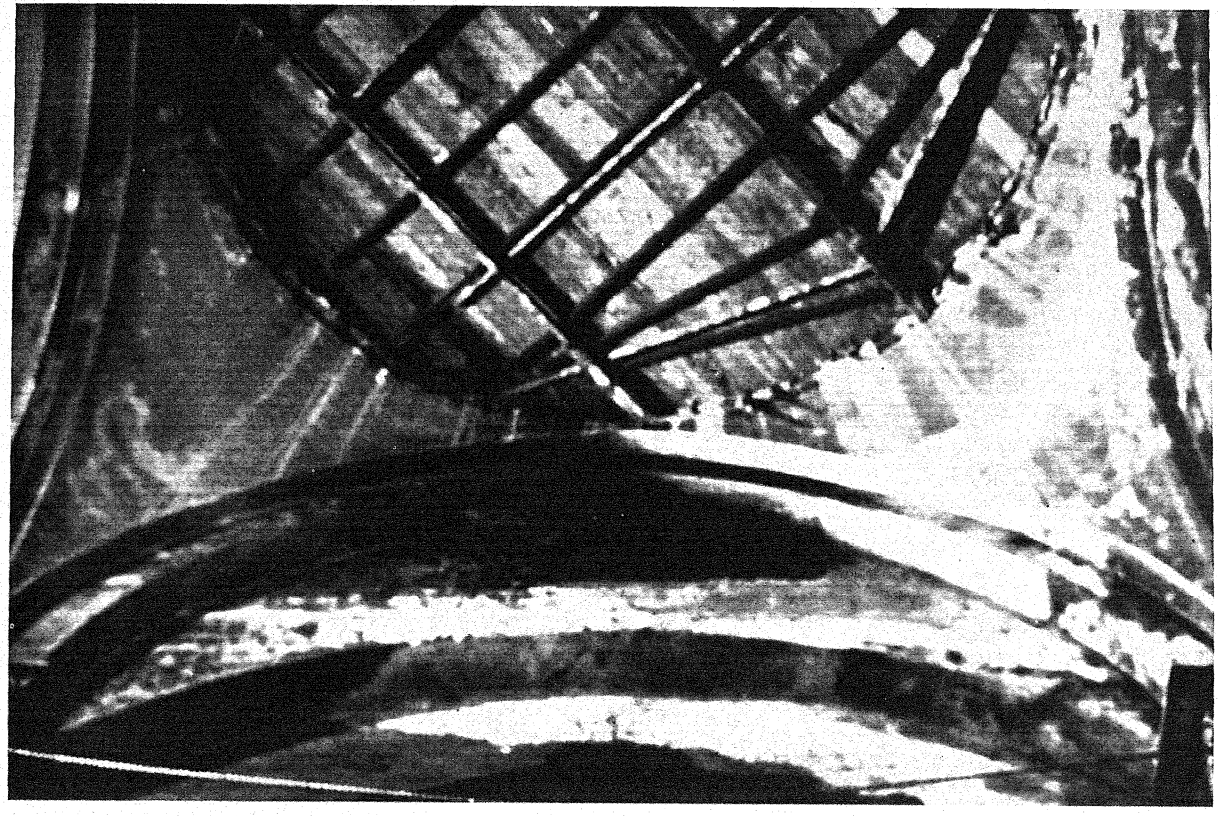


FIG. 2. WESTERN PENDENTIVES FROM BENEATH

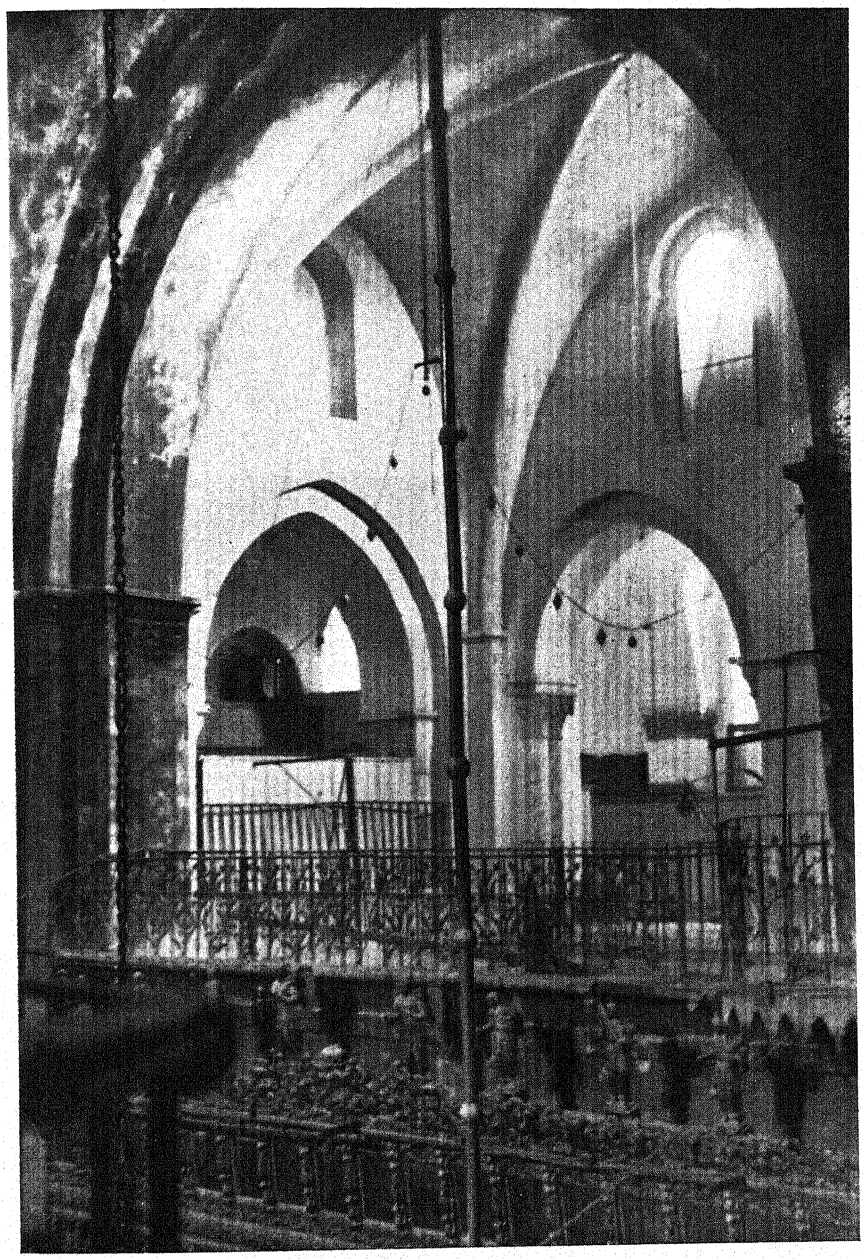


FIG. 3. NORTH TRANSEPT HIGH VAULT FROM S.E.

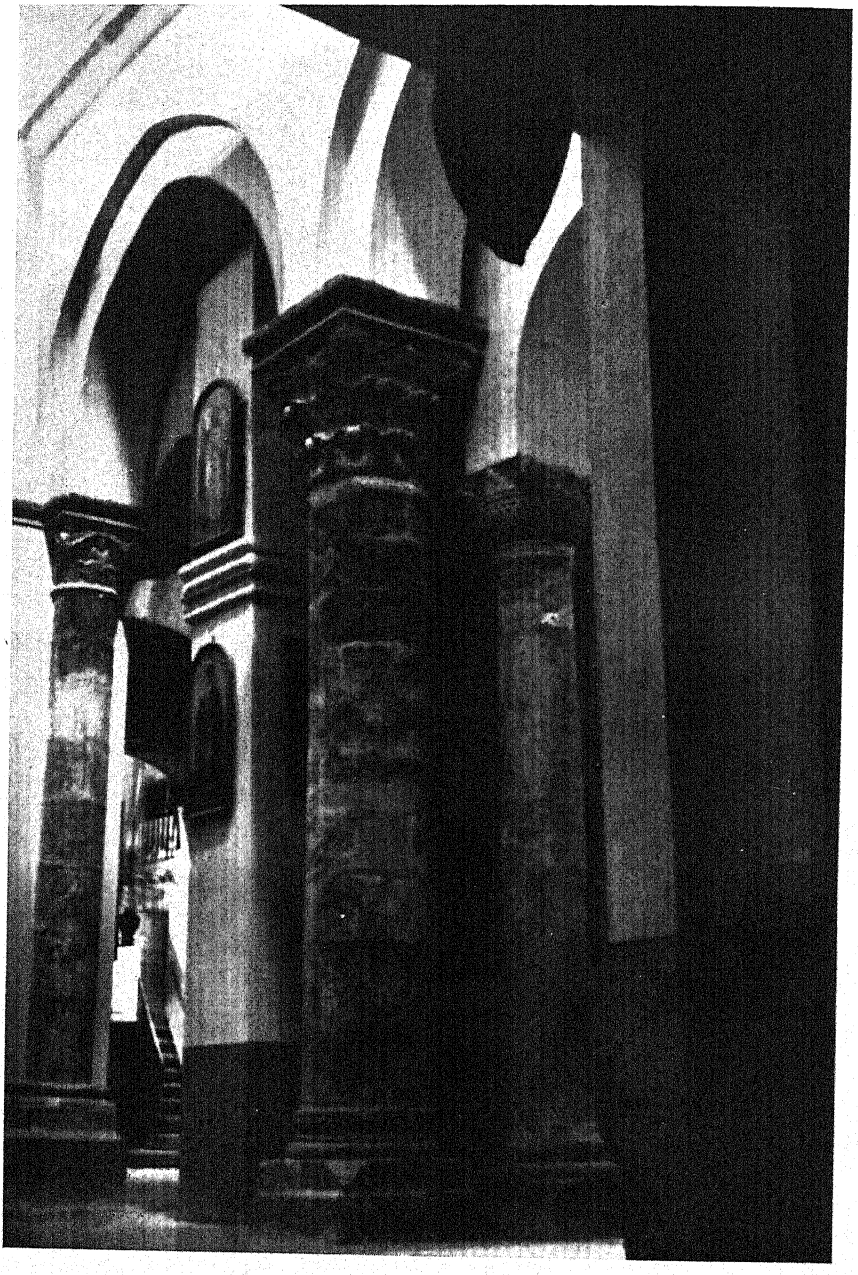


FIG. 4. COLUMNS OF NORTH TRANSEPT AND ARCADE

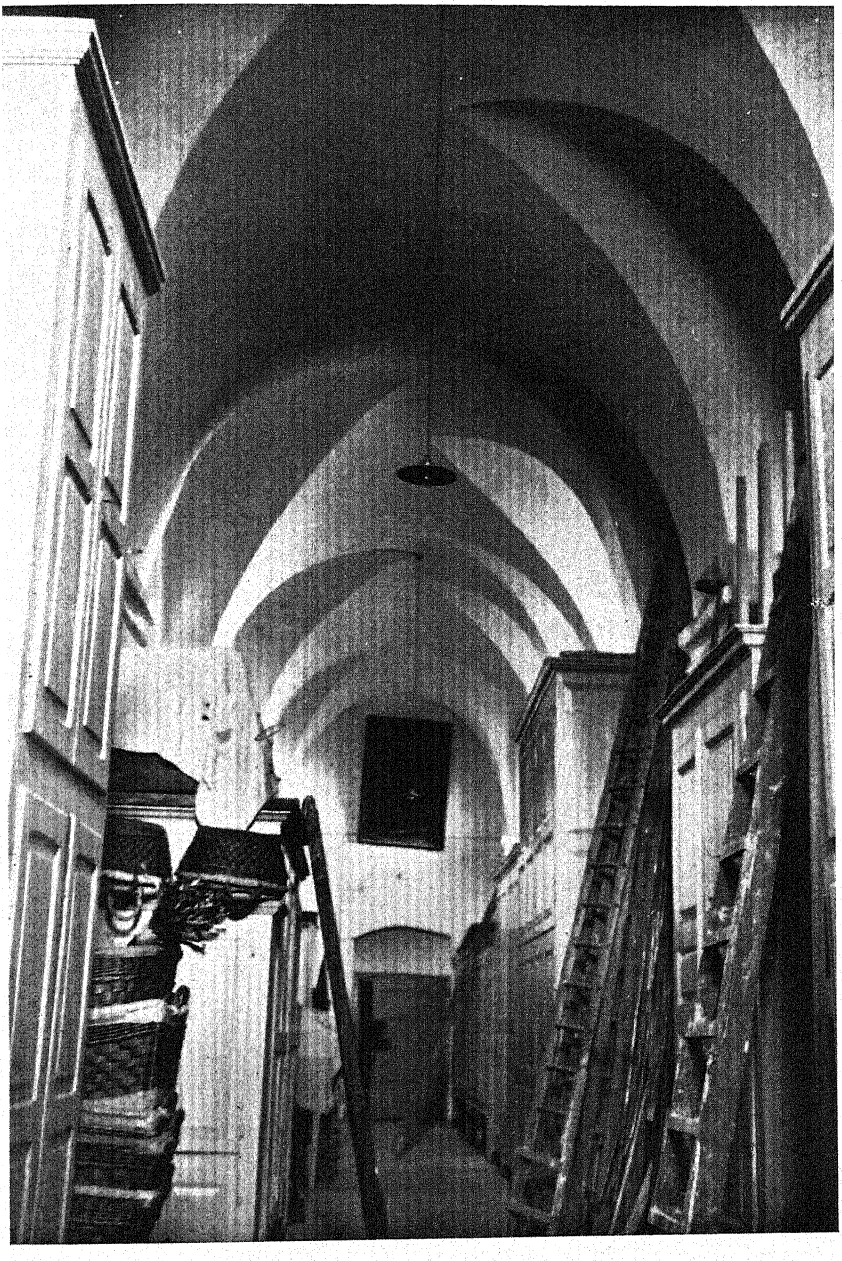


FIG. 5. NORTH TRANSEPT UPPER GALLERY FROM E.

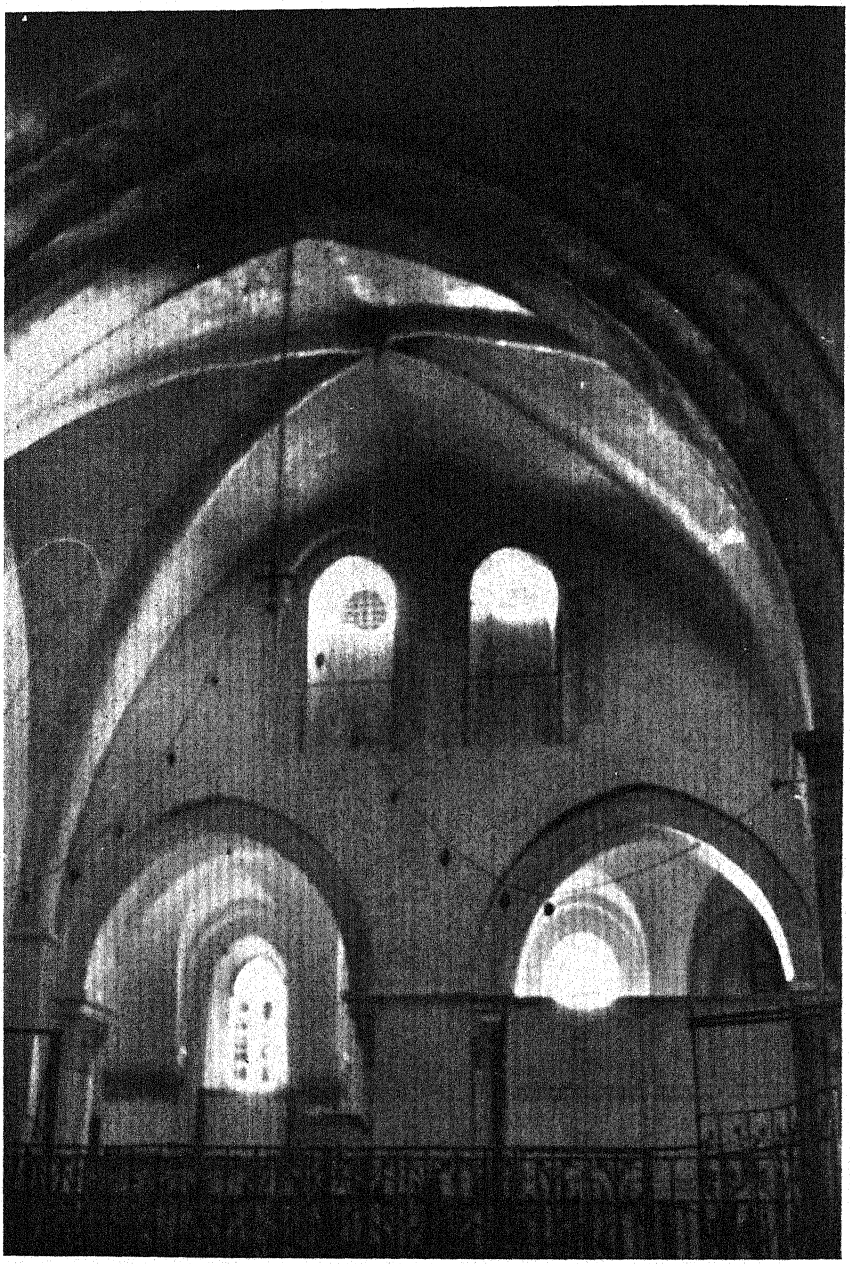


FIG. 6. NORTH TRANSEPT FROM WITHIN

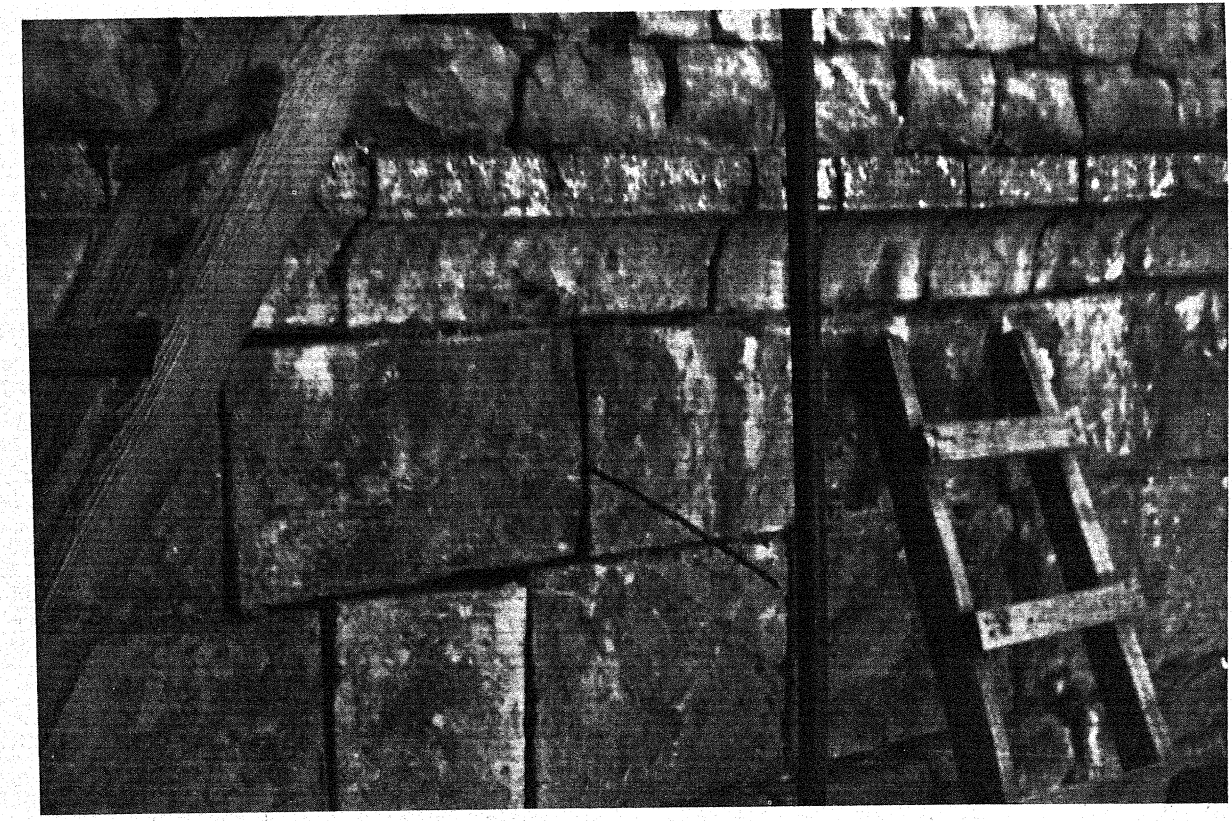


FIG. 7. CORNICE—NORTH WALL

FIG. 8. A WINDOW-HEAD—NORTH WALL

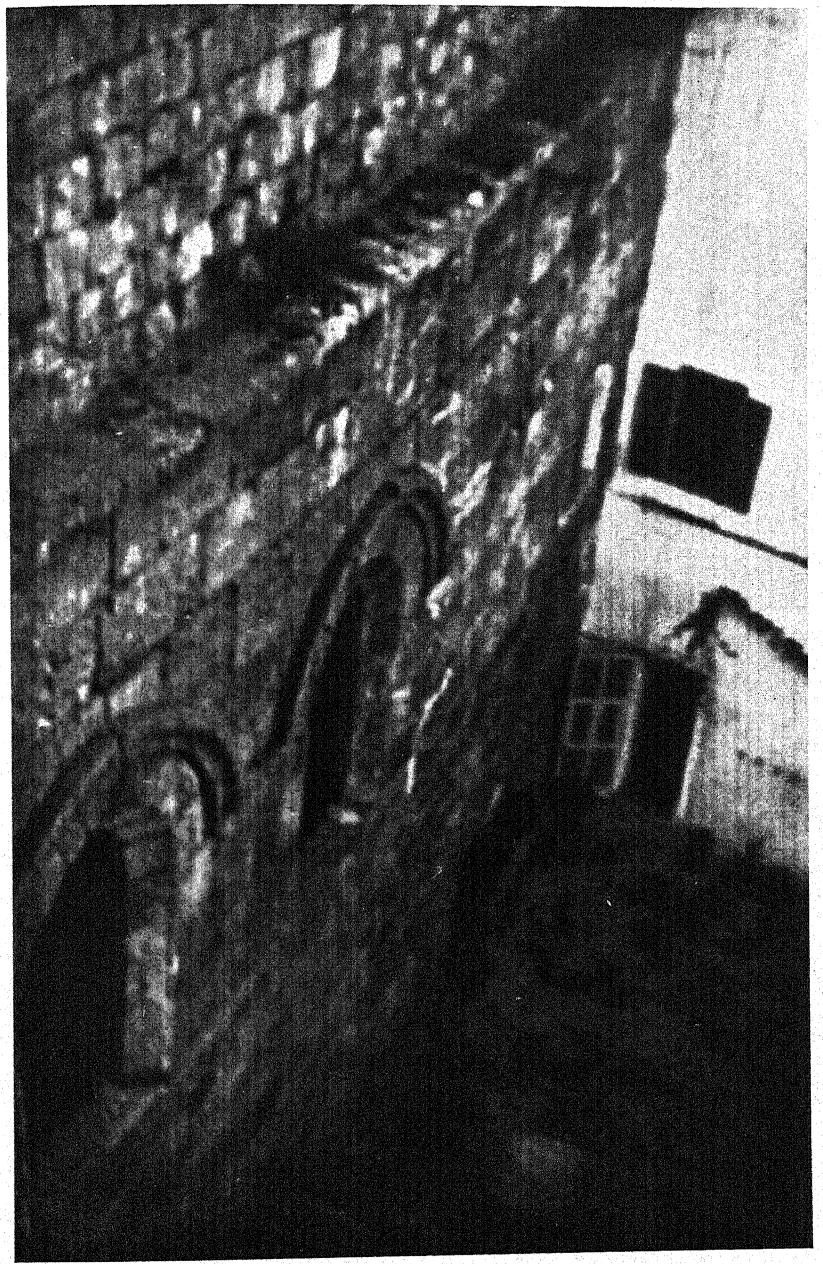
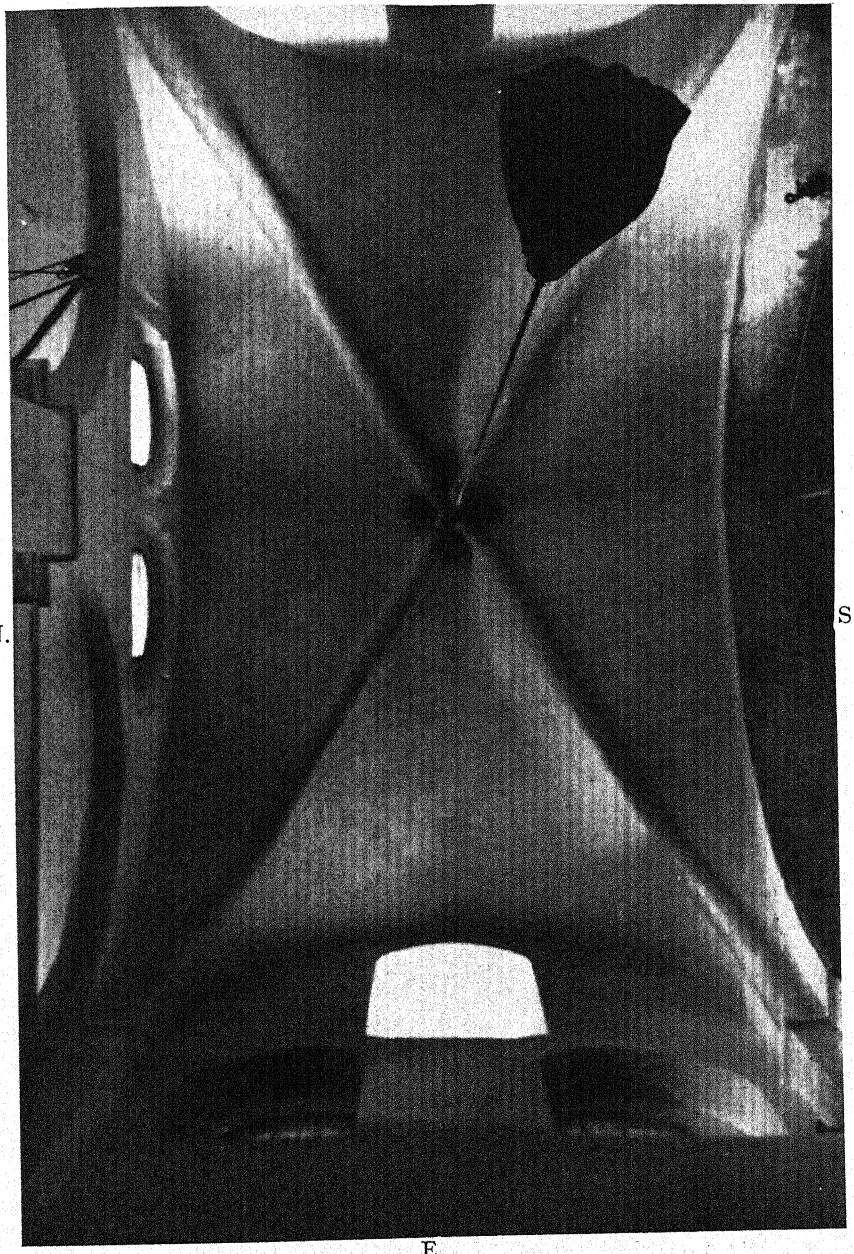


FIG. 9. NORTH WALL FROM ABOVE

(*Photo. by Antiquities Dept.*)

FIG. 10. VAULT OF NORTH TRANSEPT UPPER GALLERY—
BEFORE RE-PLASTERING

W.



N. S.

E.

FIG. 11. VAULT OF NORTH TRANSEPT

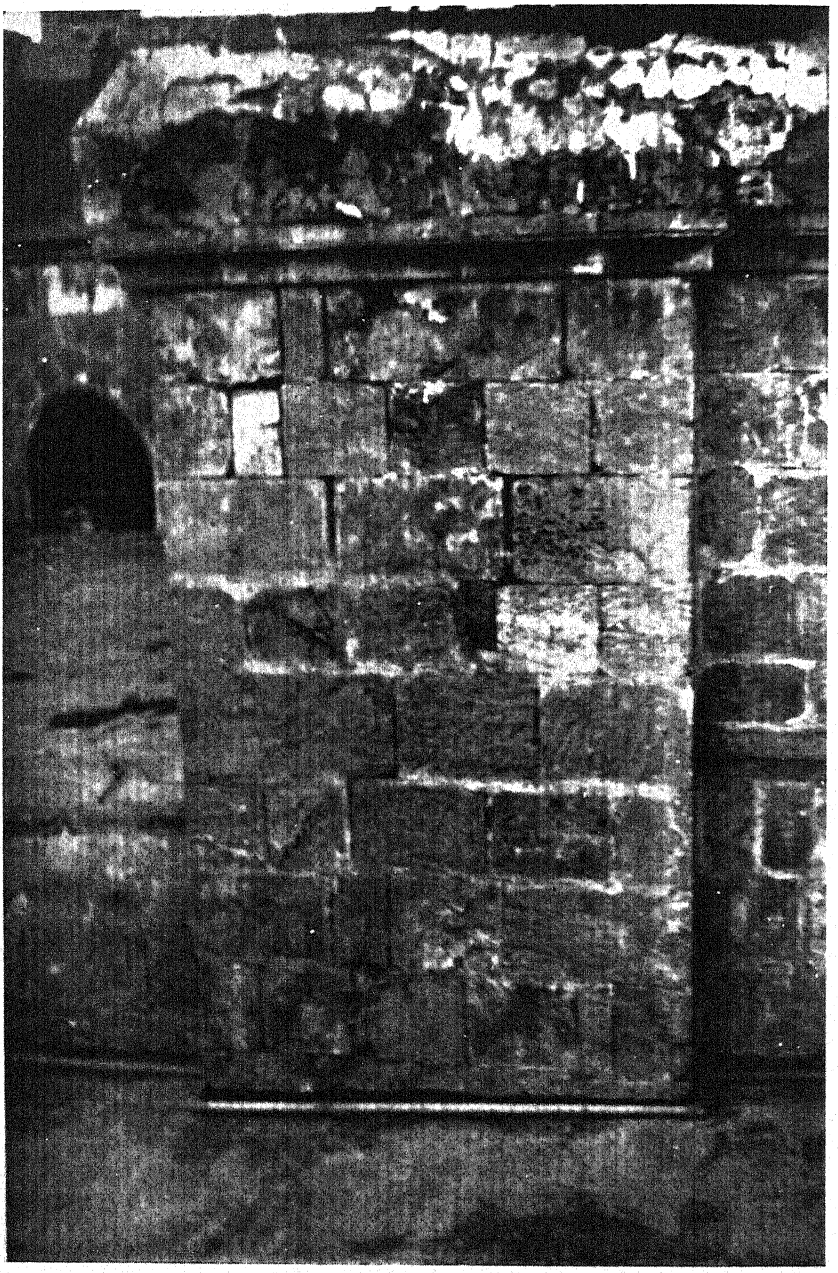


FIG. 12. N.E. CORNER OF NORTH TRANSEPT

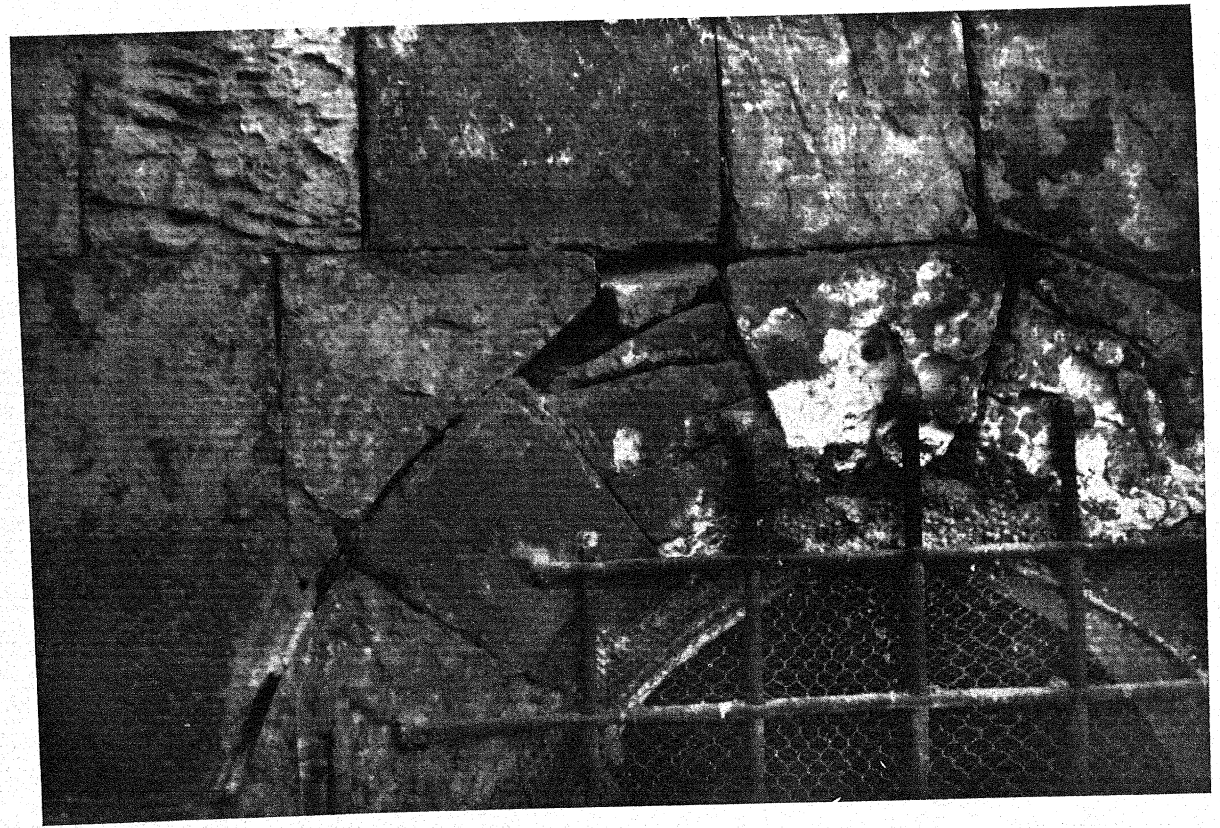


FIG. 13. NORTH TRANSEPT HIGH VAULT. E. WALL

FIG. 14. NORTH TRANSEPT HIGH VAULT. E. WALL

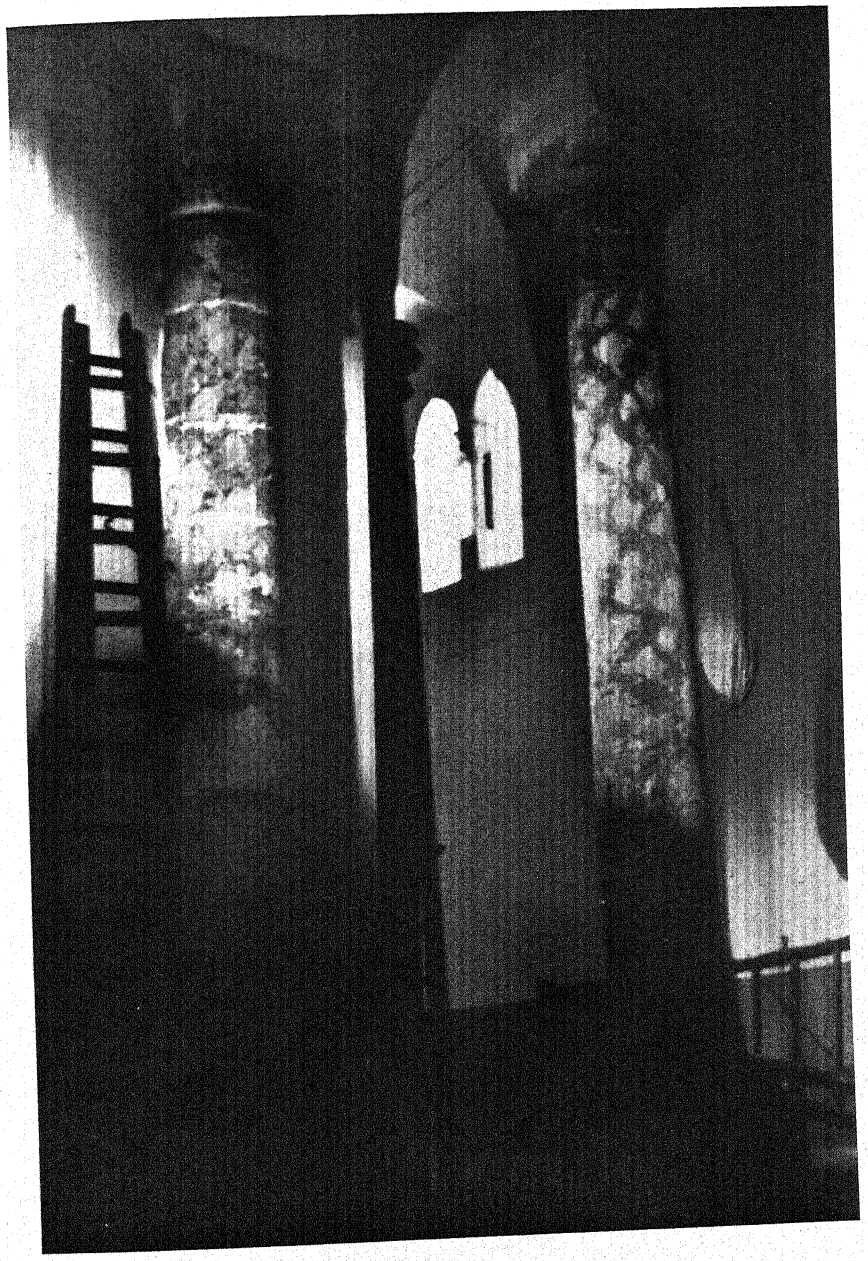


FIG. 15. E. COLUMN OF BYZANTINE ARCADE

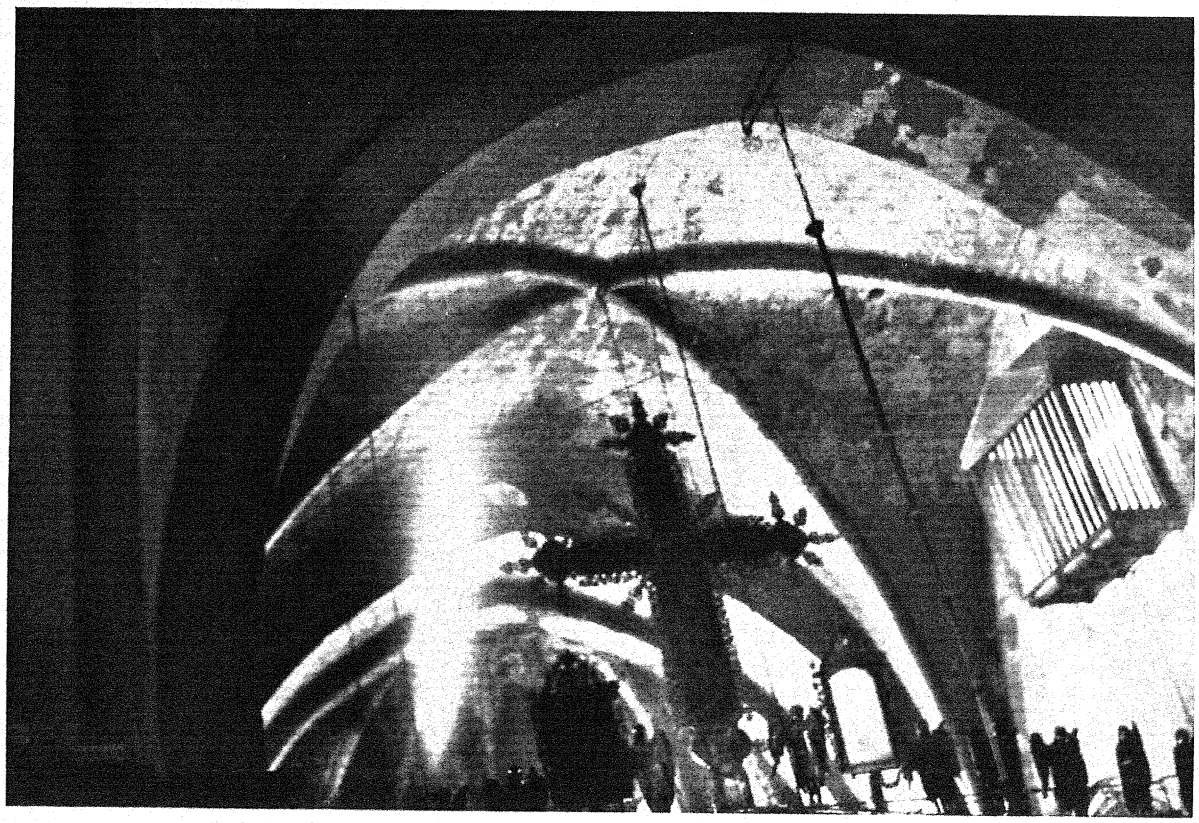


FIG. 16. EASTERN ARM HIGH VAULT FROM W.

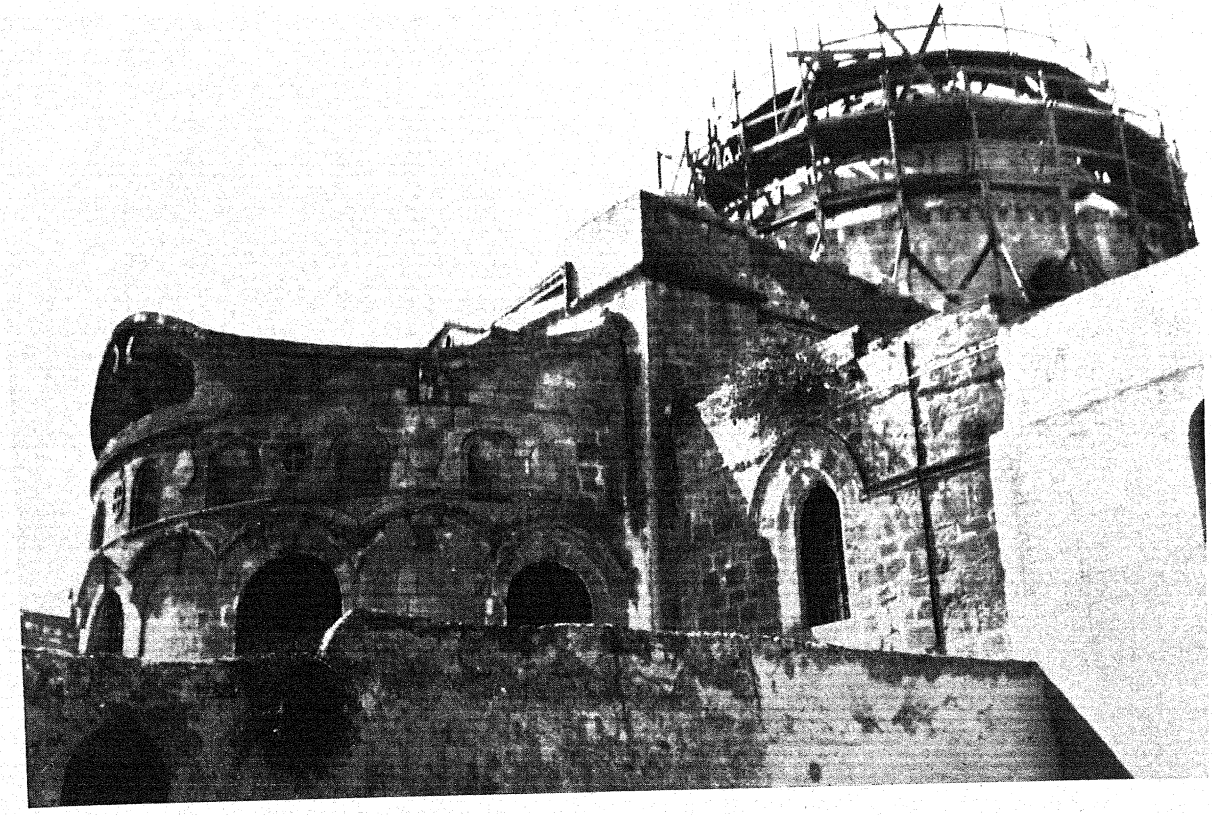


FIG. 17. EAST END FROM N.E.

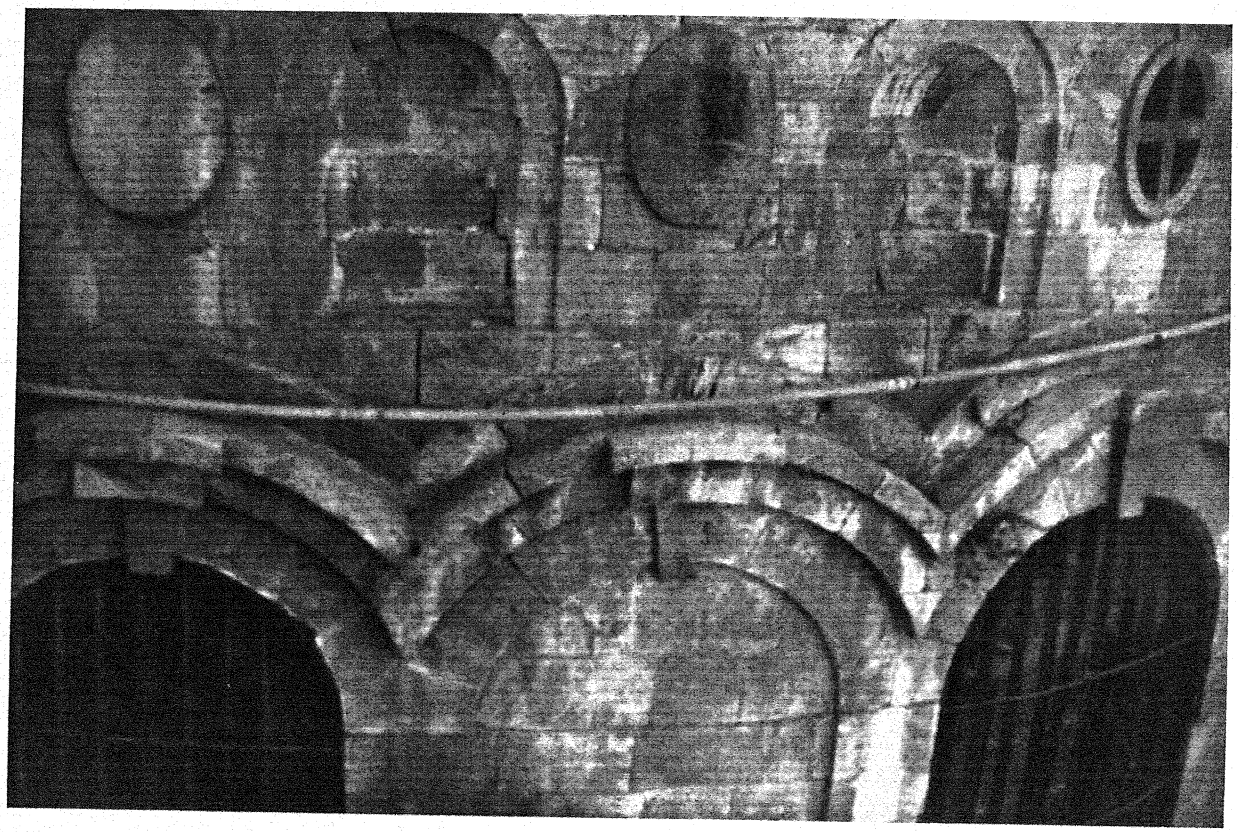


FIG. 18. APSE EXTERIOR

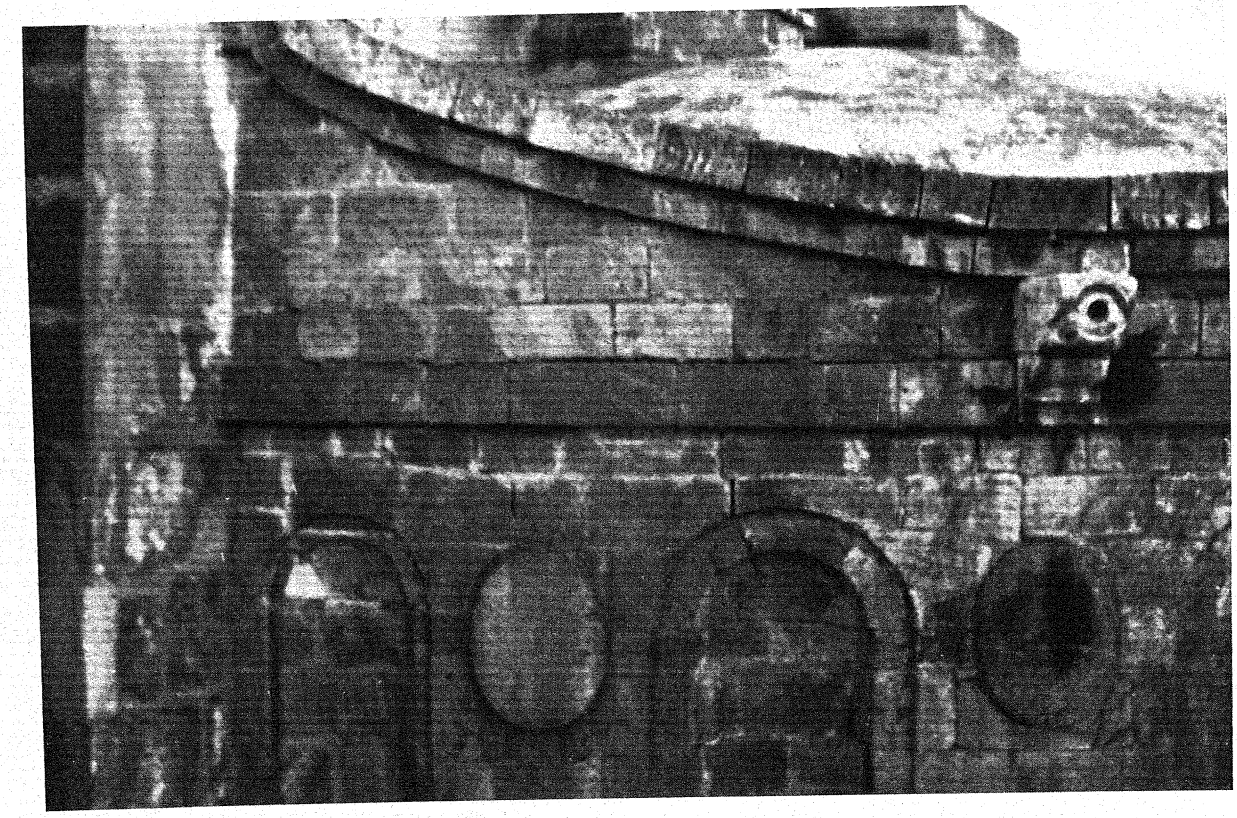


FIG. 19. APSE PARAPET

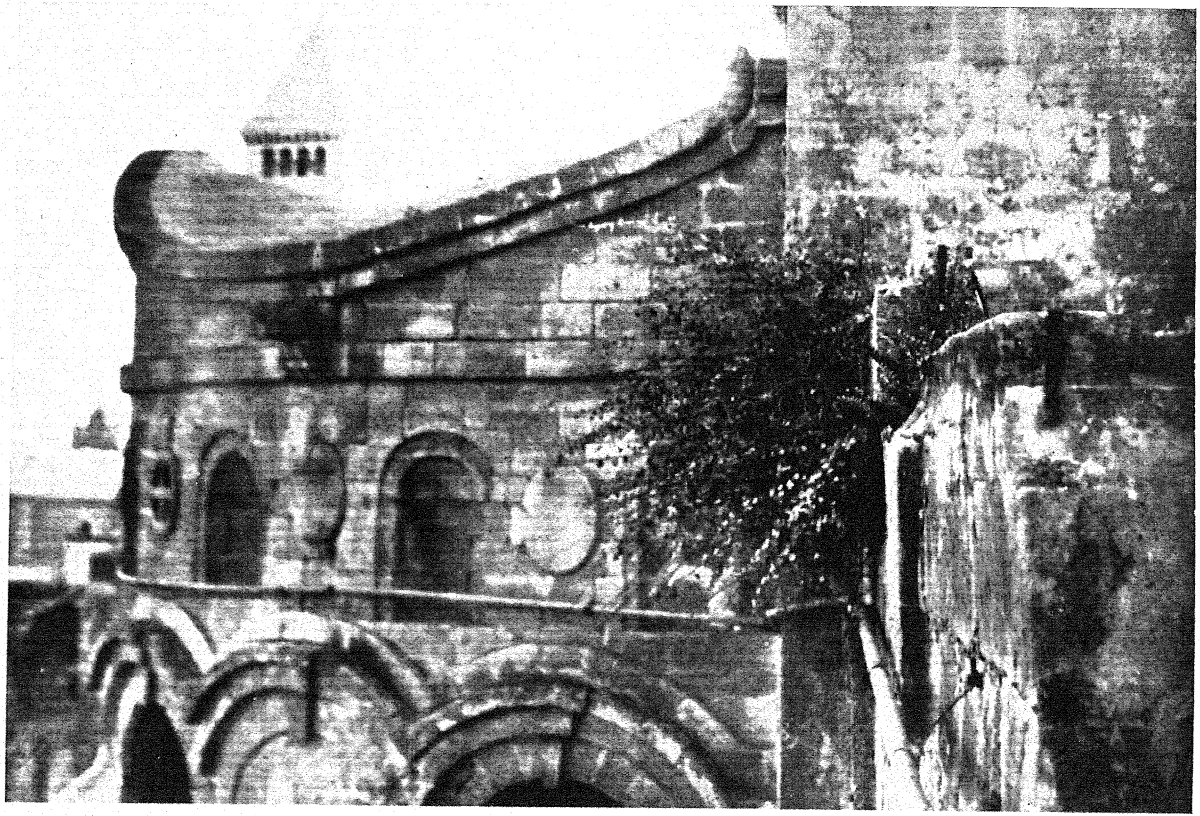


FIG. 20. APSE FROM N.

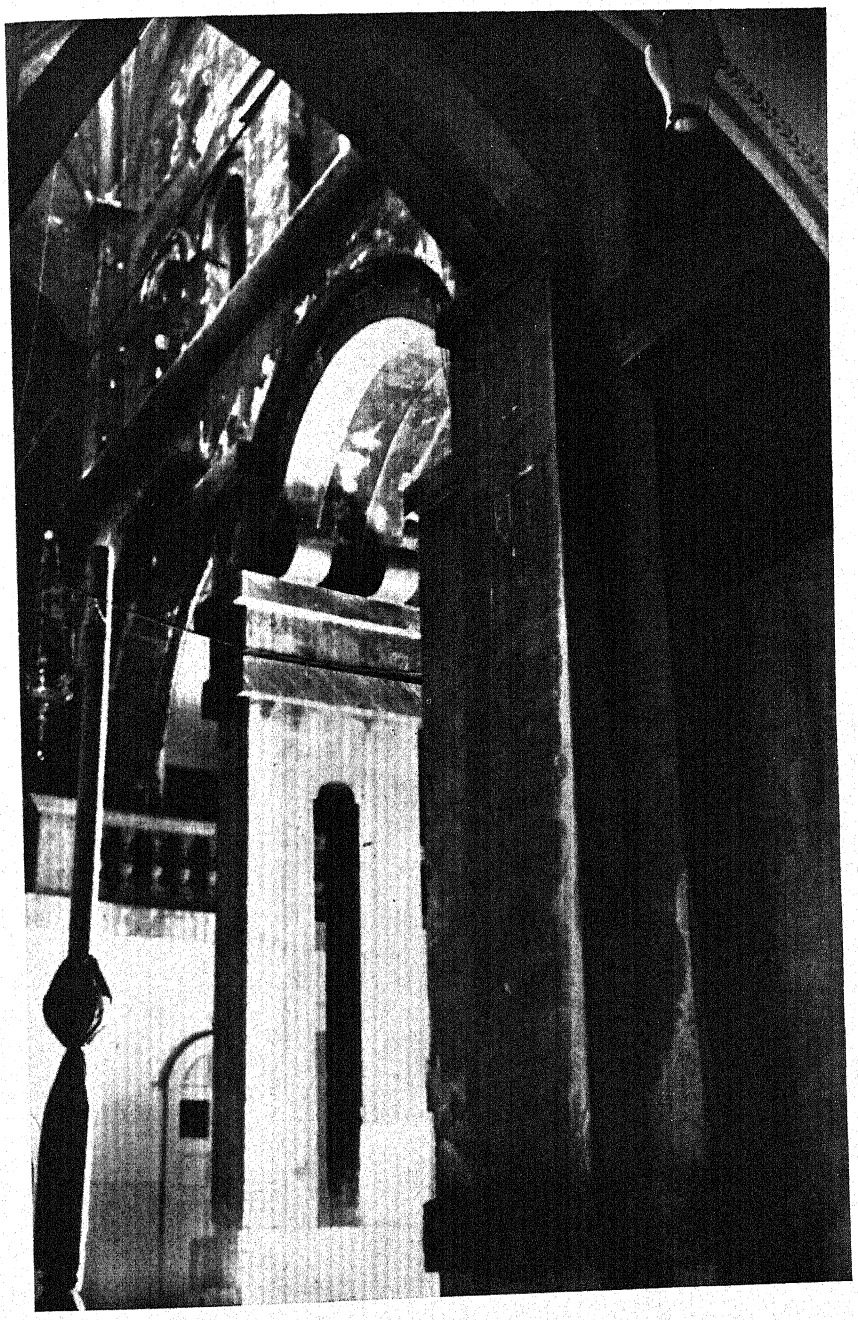


FIG. 21. SOUTH TRANSEPT FROM N.W.

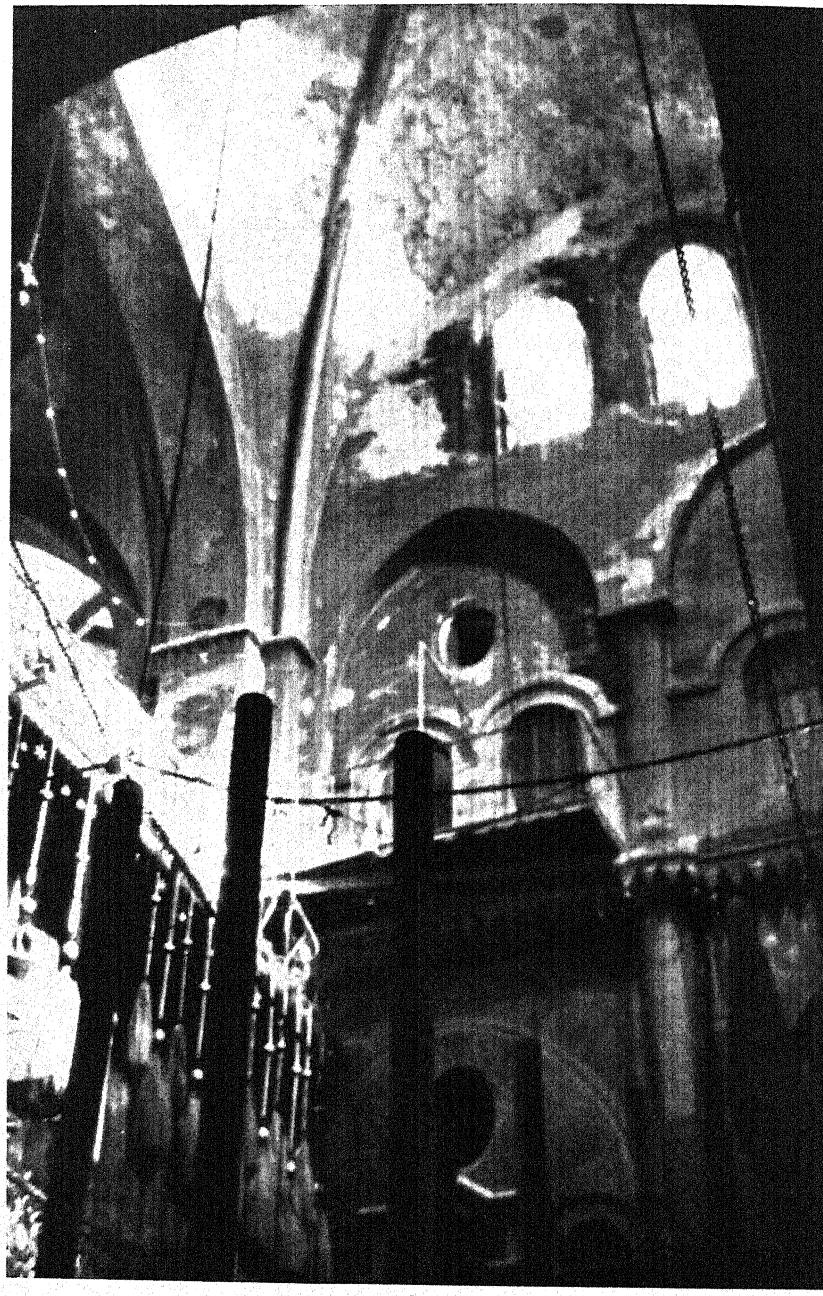
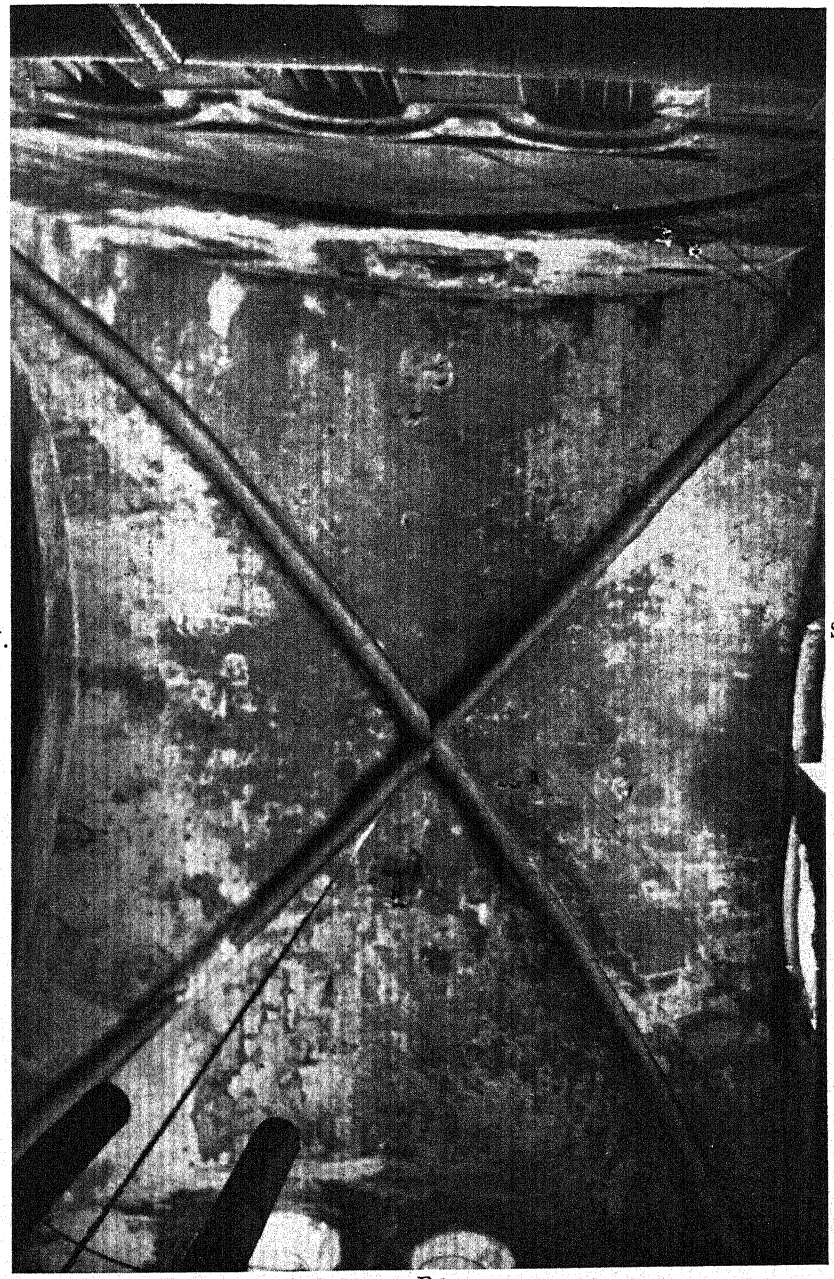


FIG. 22. SOUTH TRANSEPT E. WALL

W.

N.



S.

E.

FIG. 23. SOUTH TRANSEPT VAULT

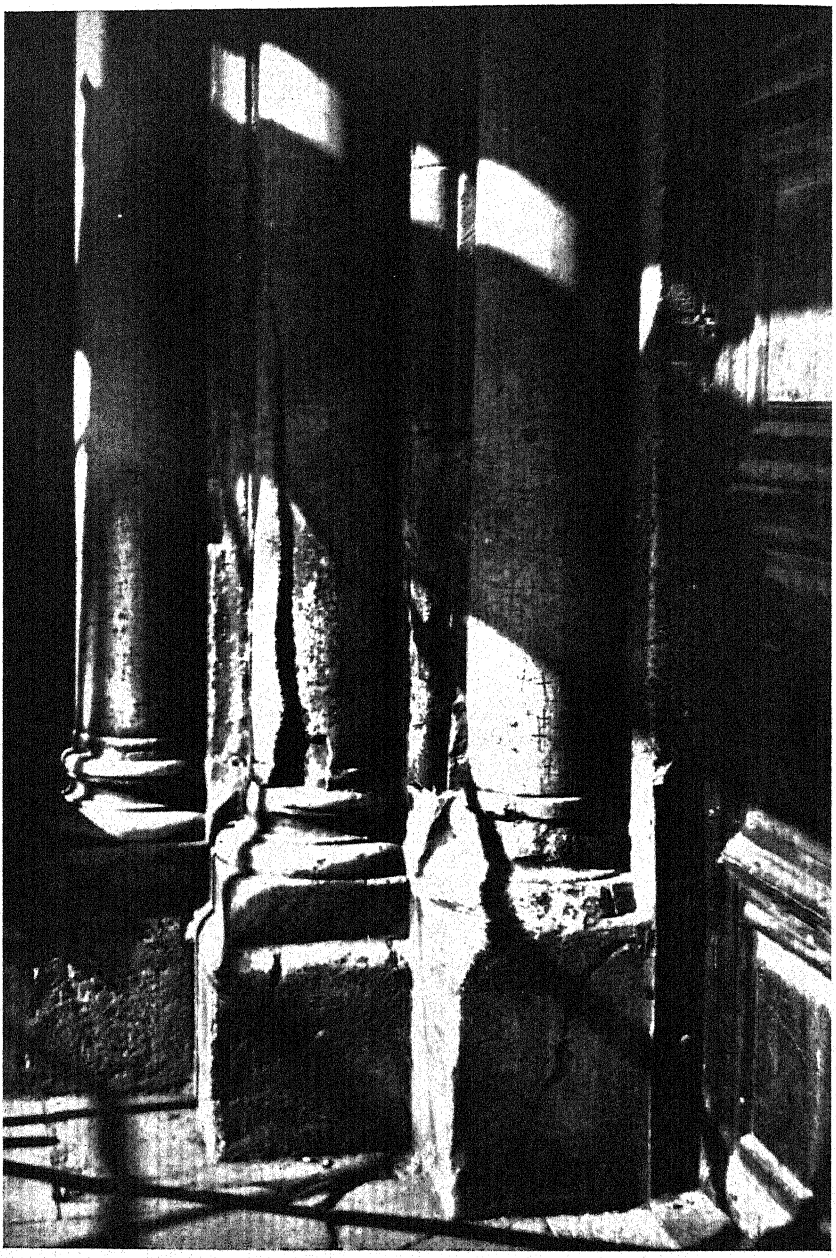


FIG. 24. BASES TO W. OF MAIN DOOR

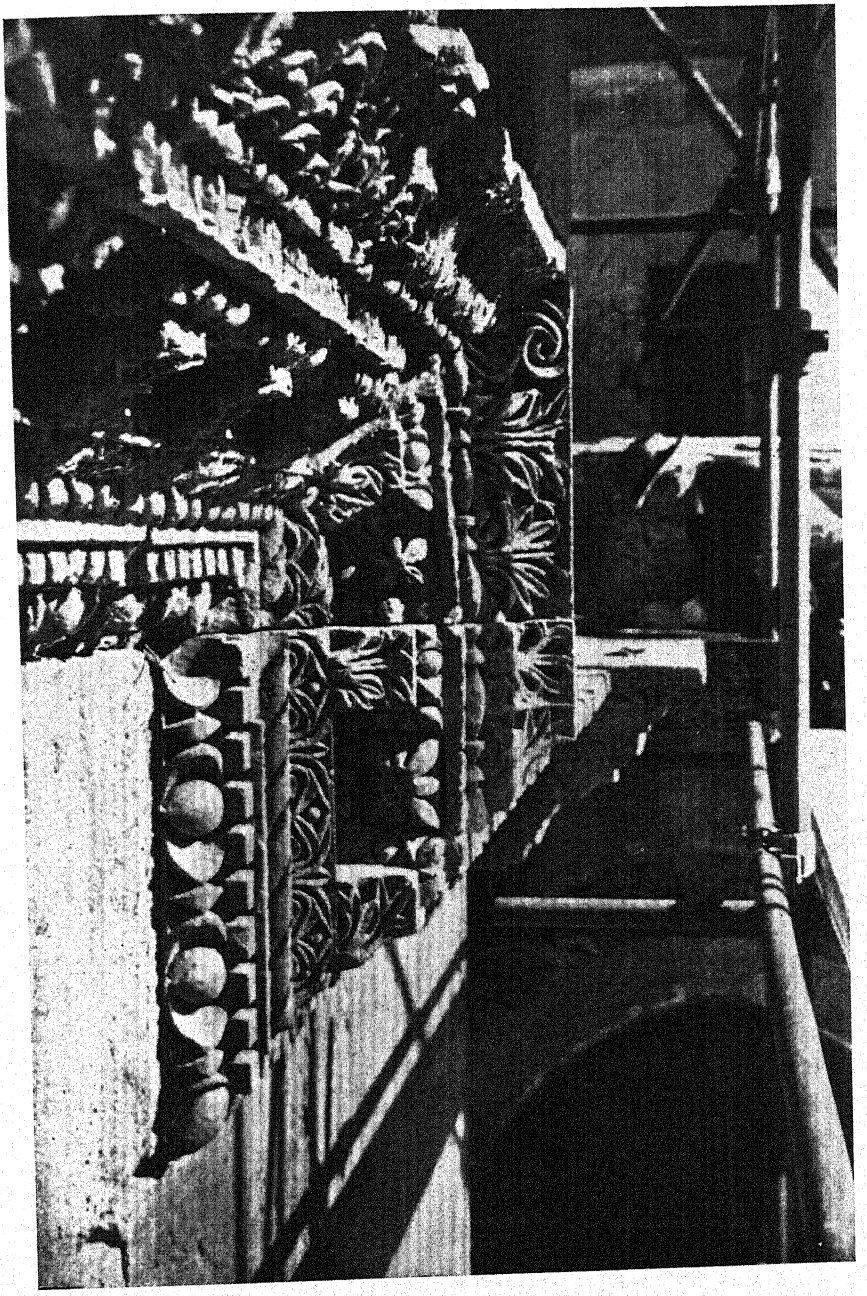


FIG. 25. MAIN FRONT—LOWER CORNICE

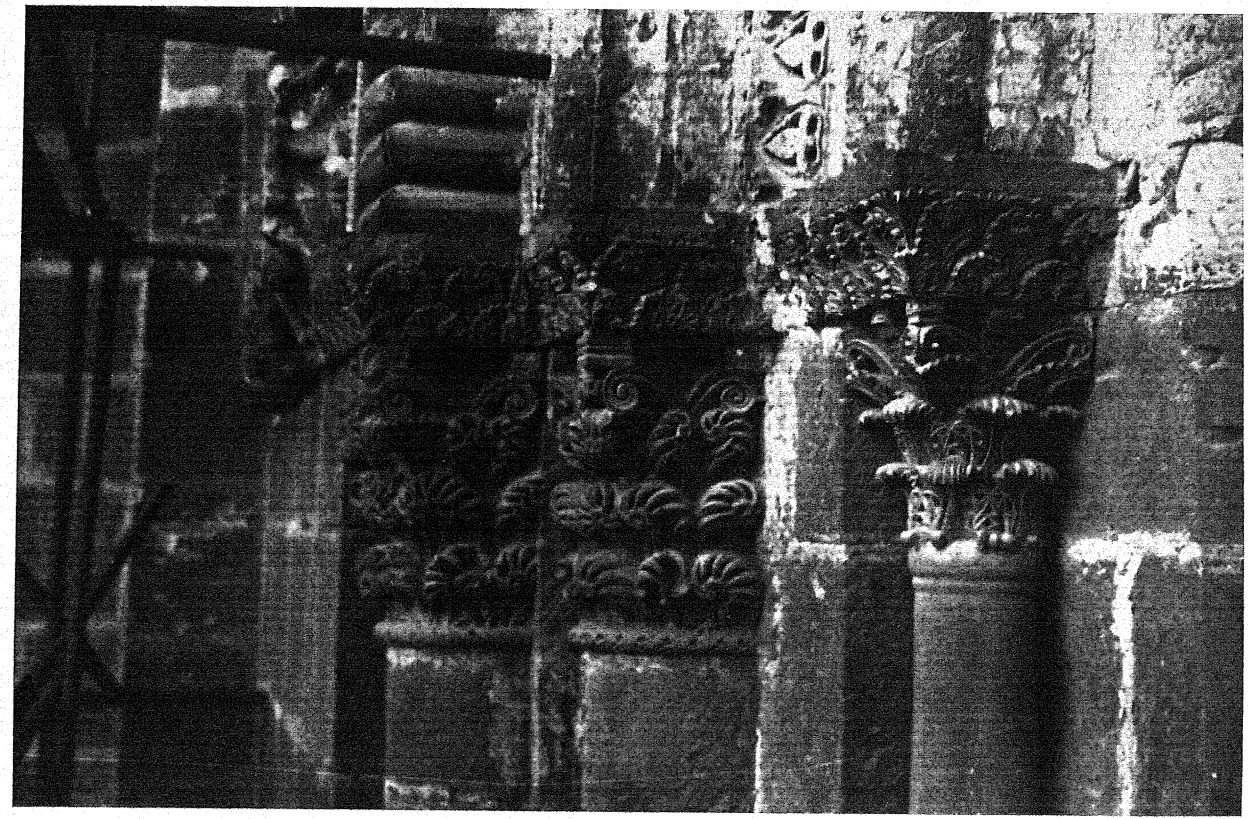


FIG. 26. MAIN FRONT. CAPITALS OF UPPER W. WINDOW

FIG. 27. MAIN FRONT. CENTRAL CAPITALS TO UPPER WINDOWS

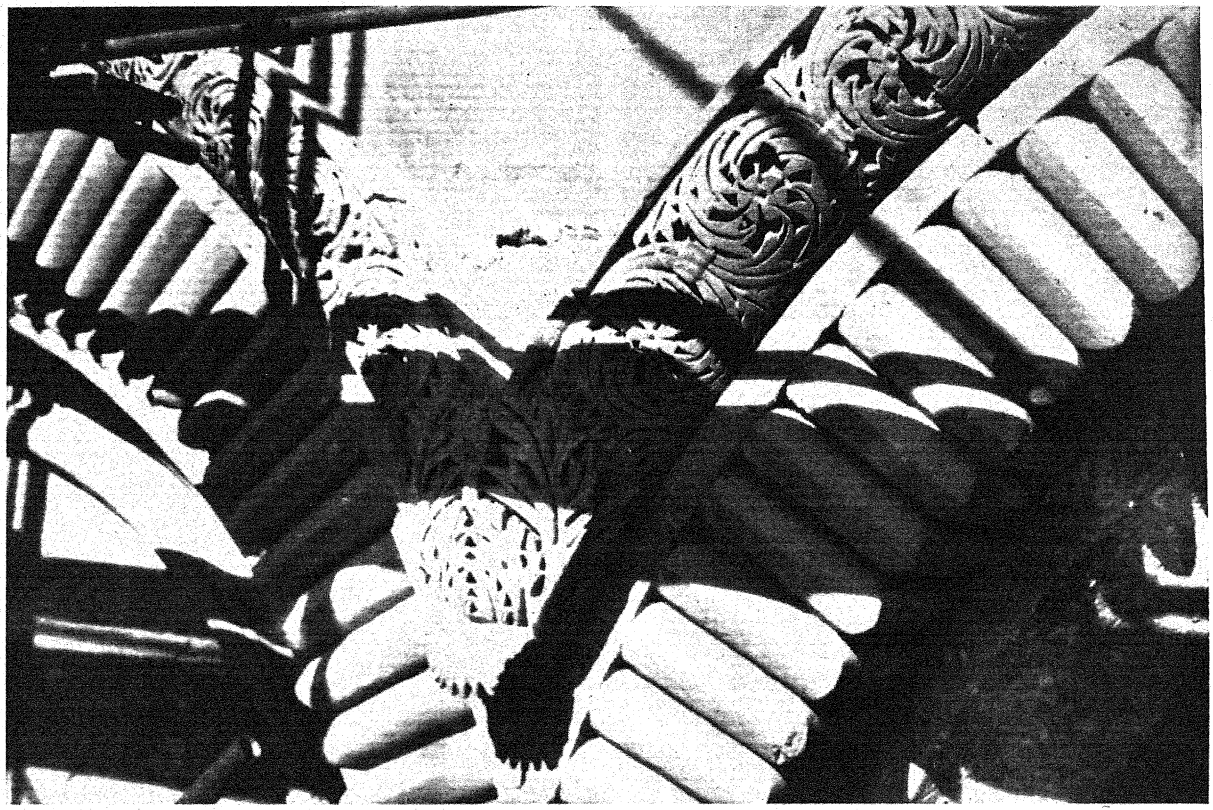


FIG. 28. SPANDREL CARVING OF LOWER STRING-COURSE OVER DOORS

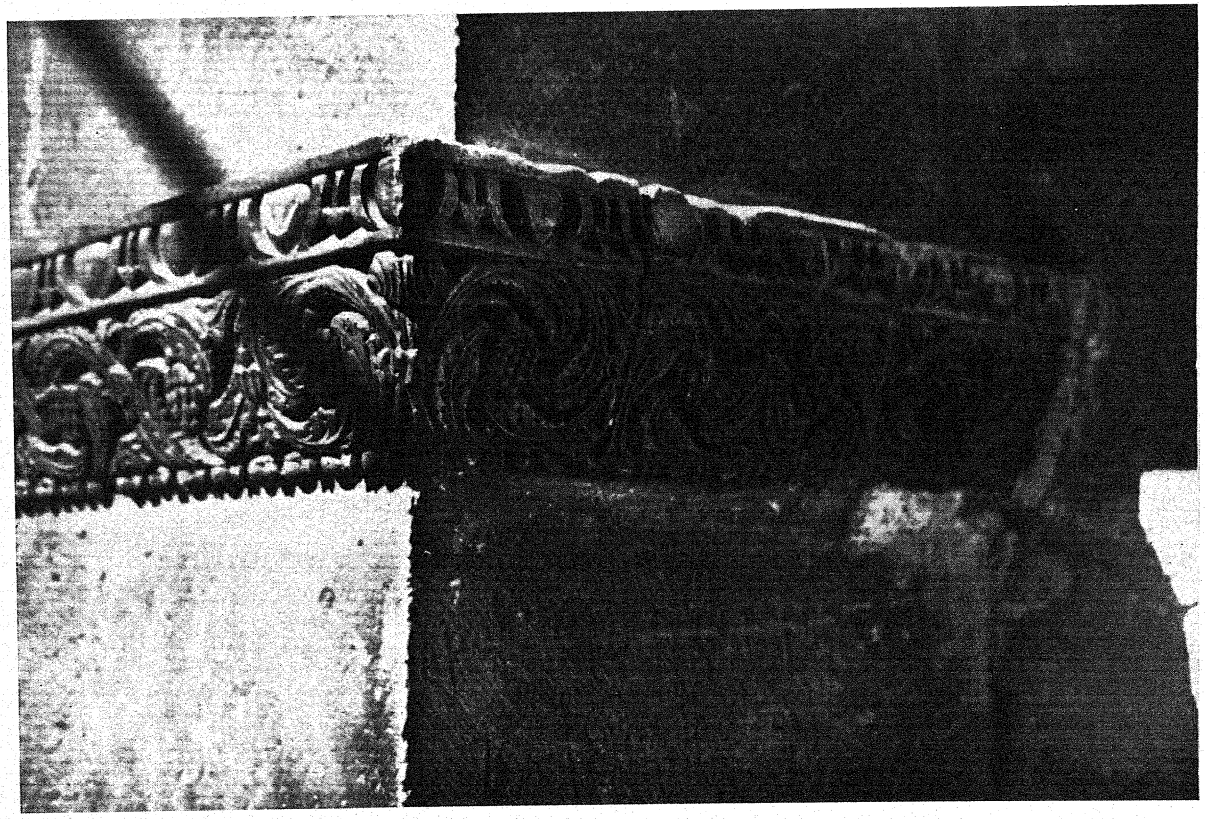


FIG. 29. MARBLE IMPOST MOULDING TO DOOR ARCHES

FIG. 30. UPPER ARCHES OF FRONT

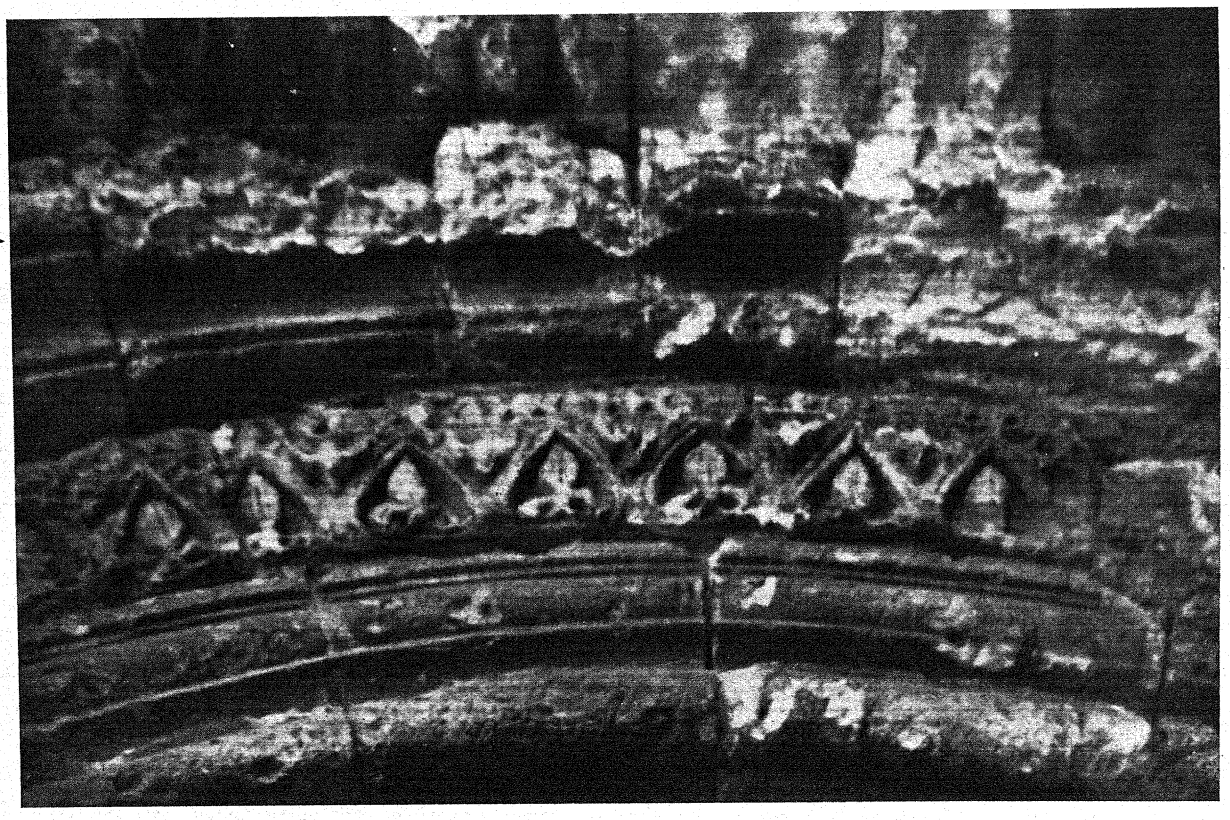


FIG. 31. PART OF CALCINED MOULDINGS TO UPPER ARCHES

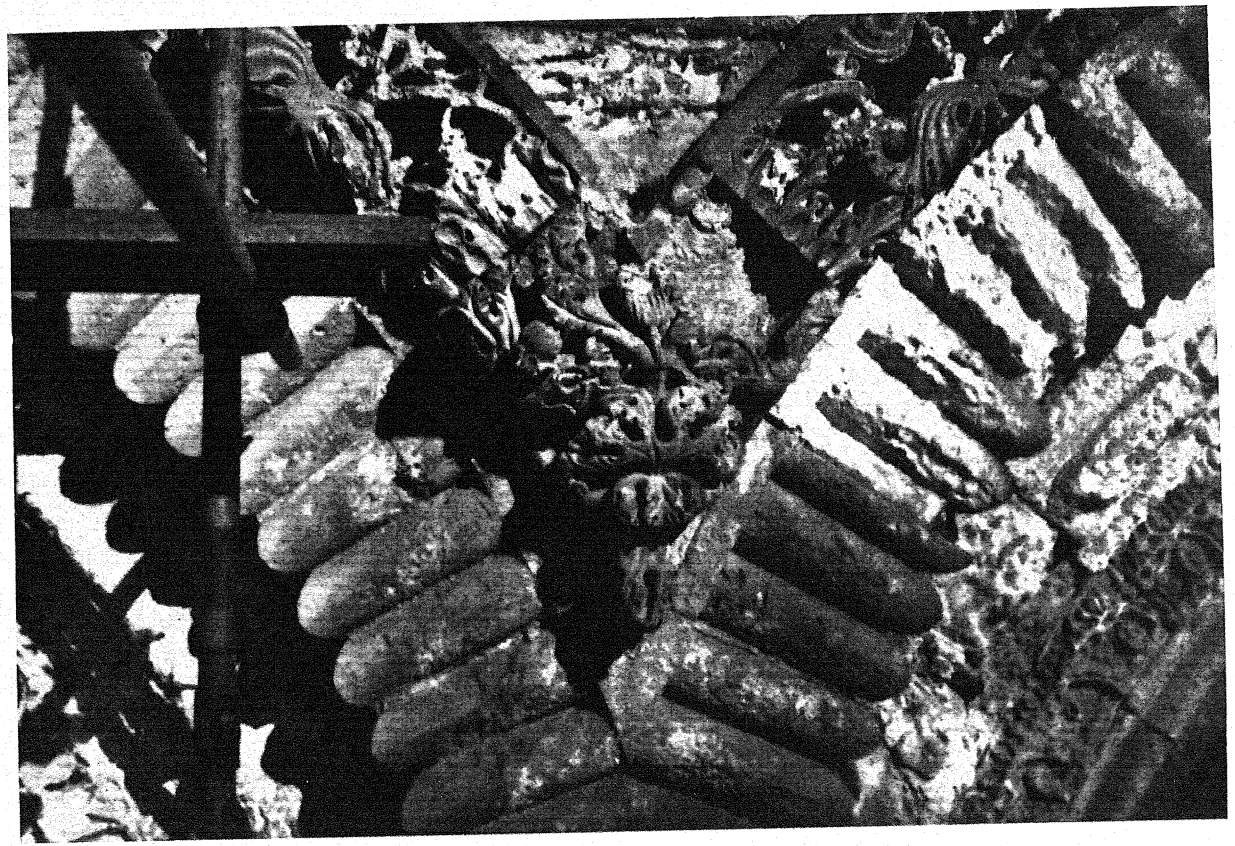


FIG. 32. SPANDREL CARVING OF UPPER STRING-COURSE OVER WINDOWS

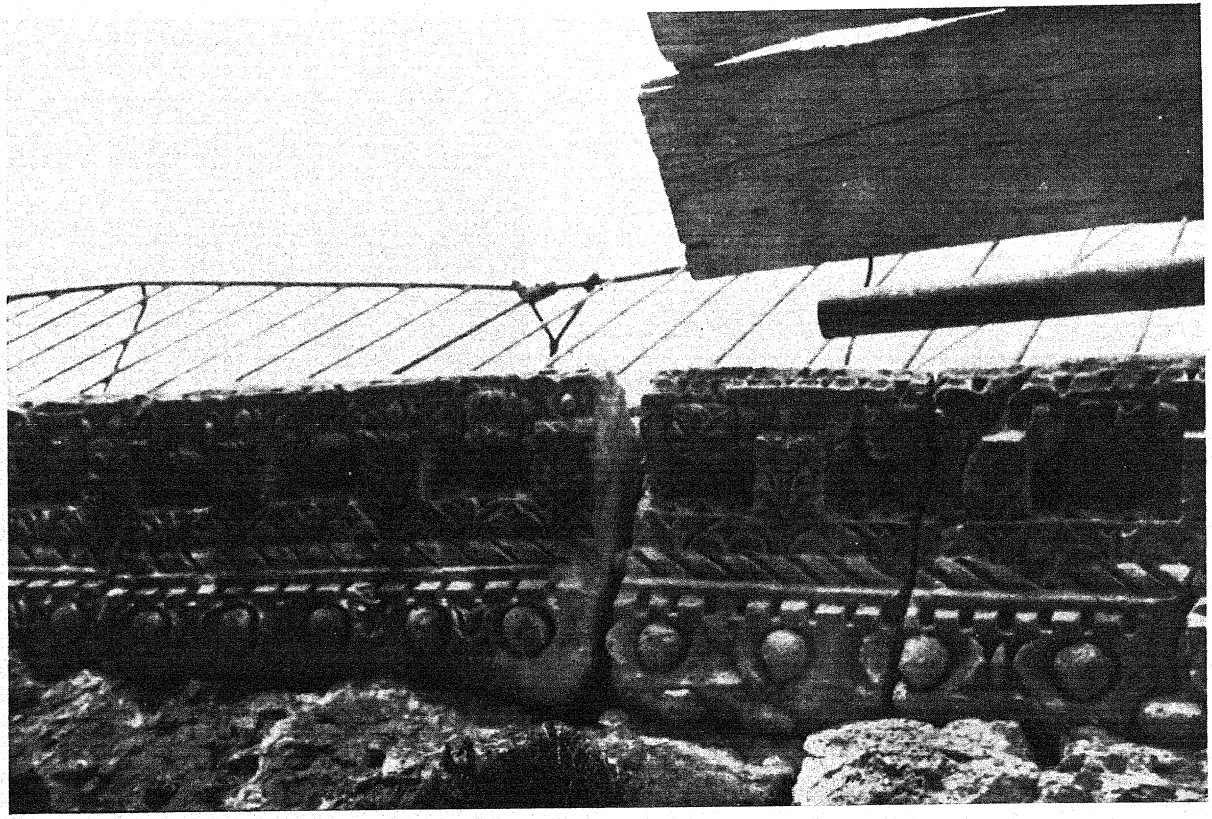


FIG. 33. DISLOCATED BLOCKS OF MAIN CORNICE

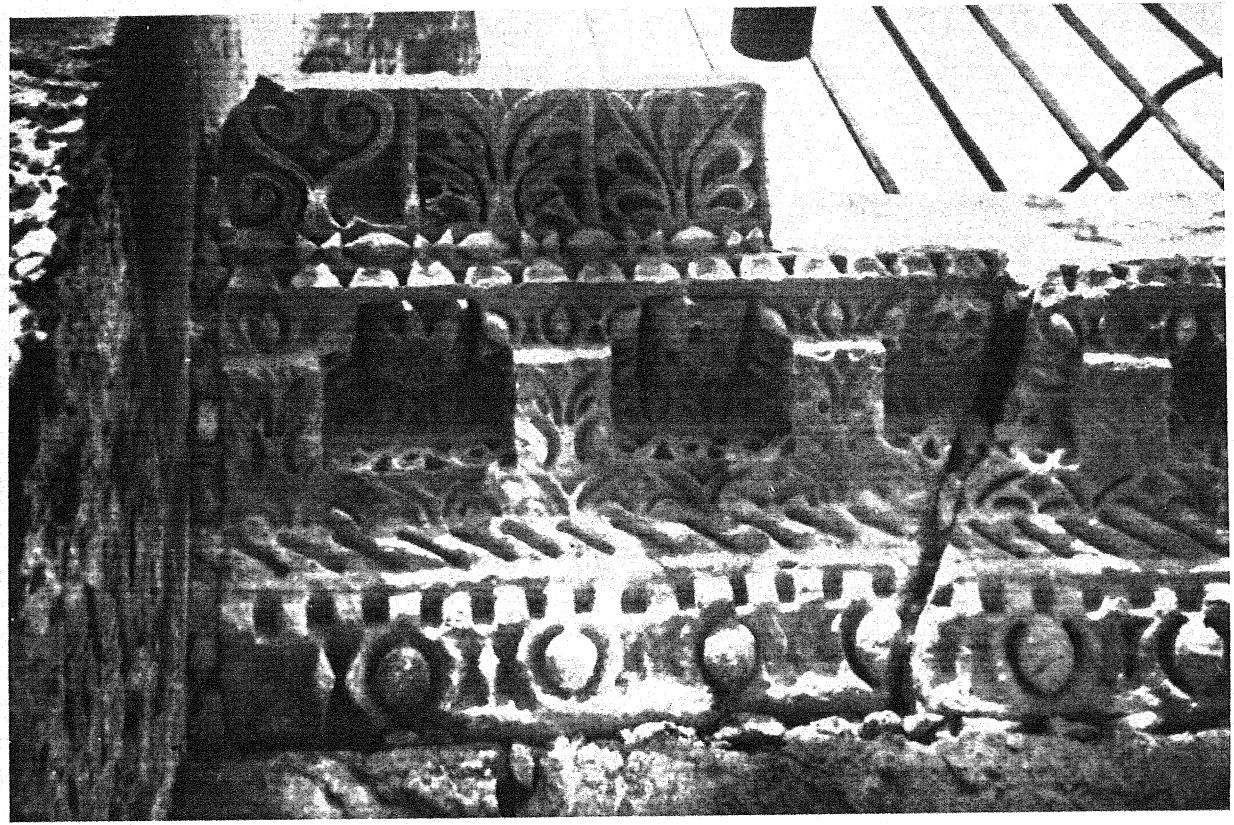


FIG. 34. CORNICE TO E. OF MAIN FRONT

FIG. 35. E. END OF MAIN FRONT WALL-TOP

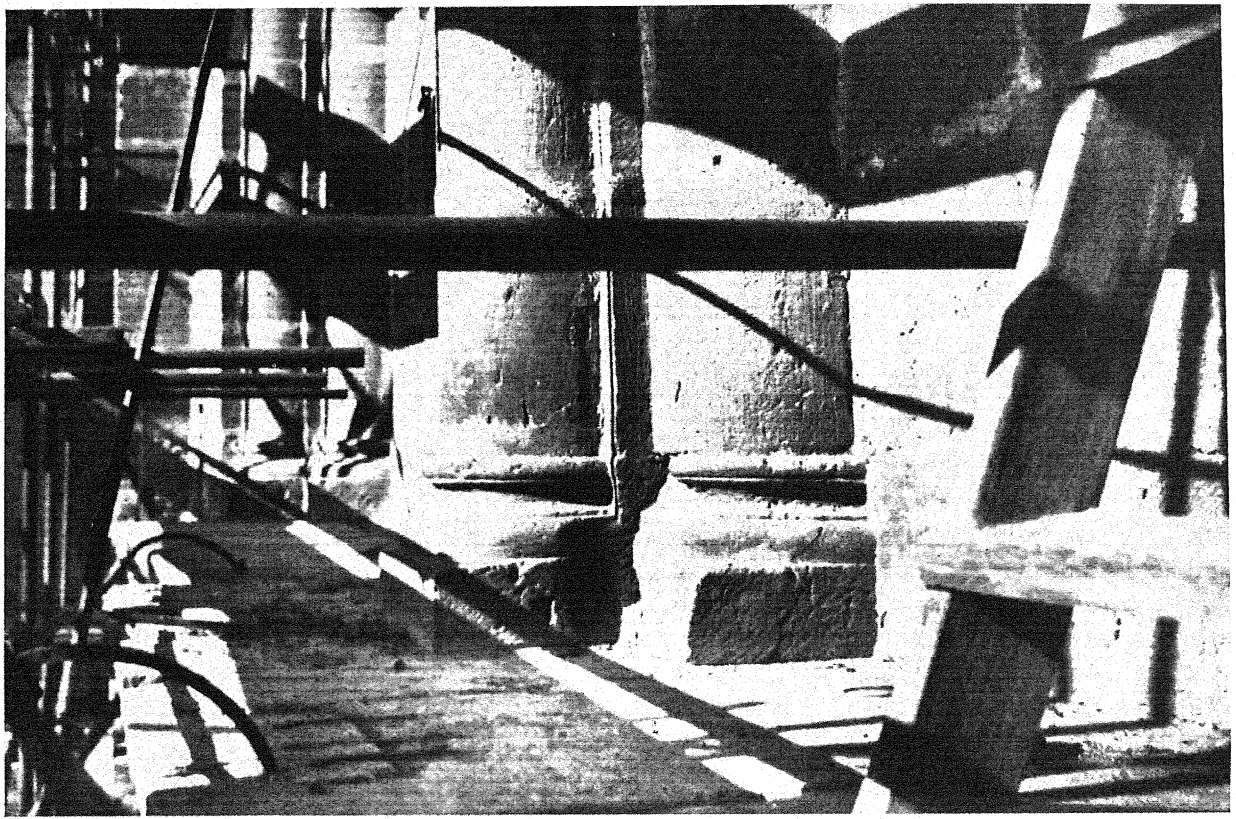


FIG. 36. CRACKED BASES OF PIERS OF UPPER ARCADE

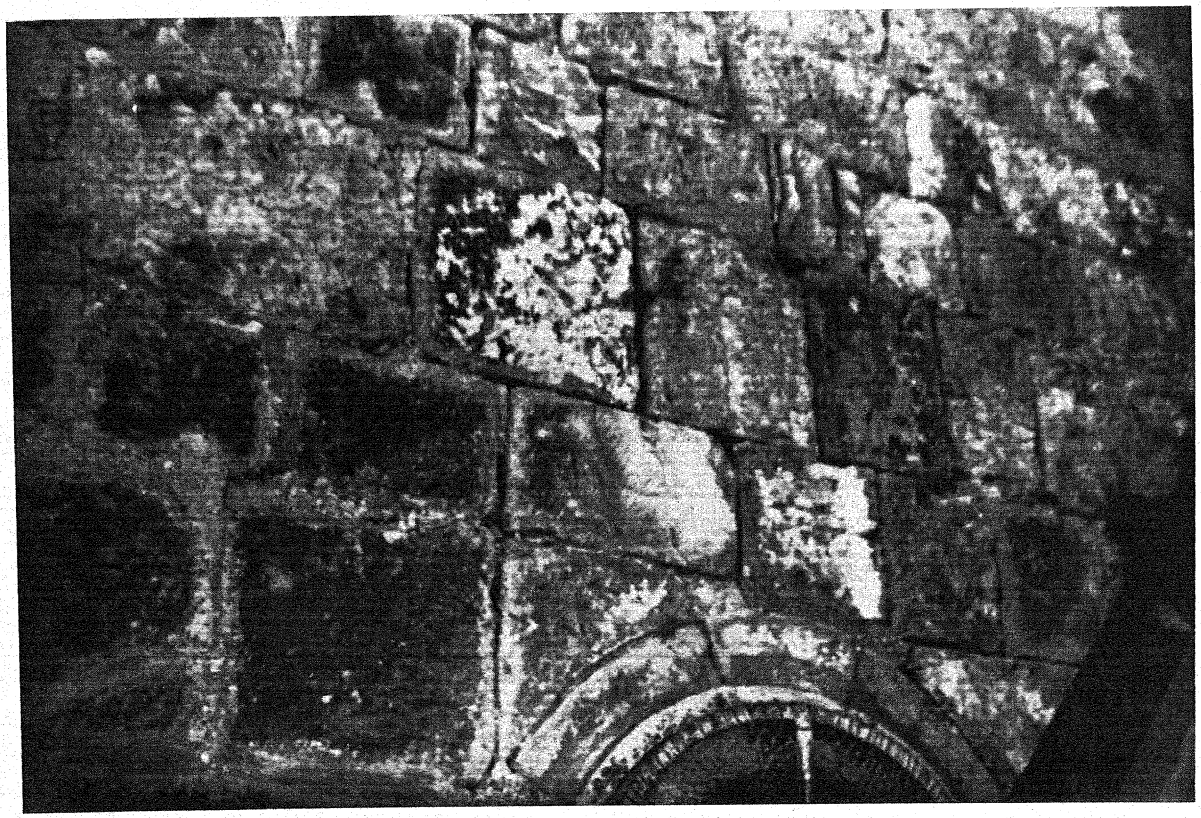


FIG. 36*a*. SOUTH TRANSEPT HIGH VAULT E. WALL TO SHOW FRACTURES IN MASONRY AND JOINTS

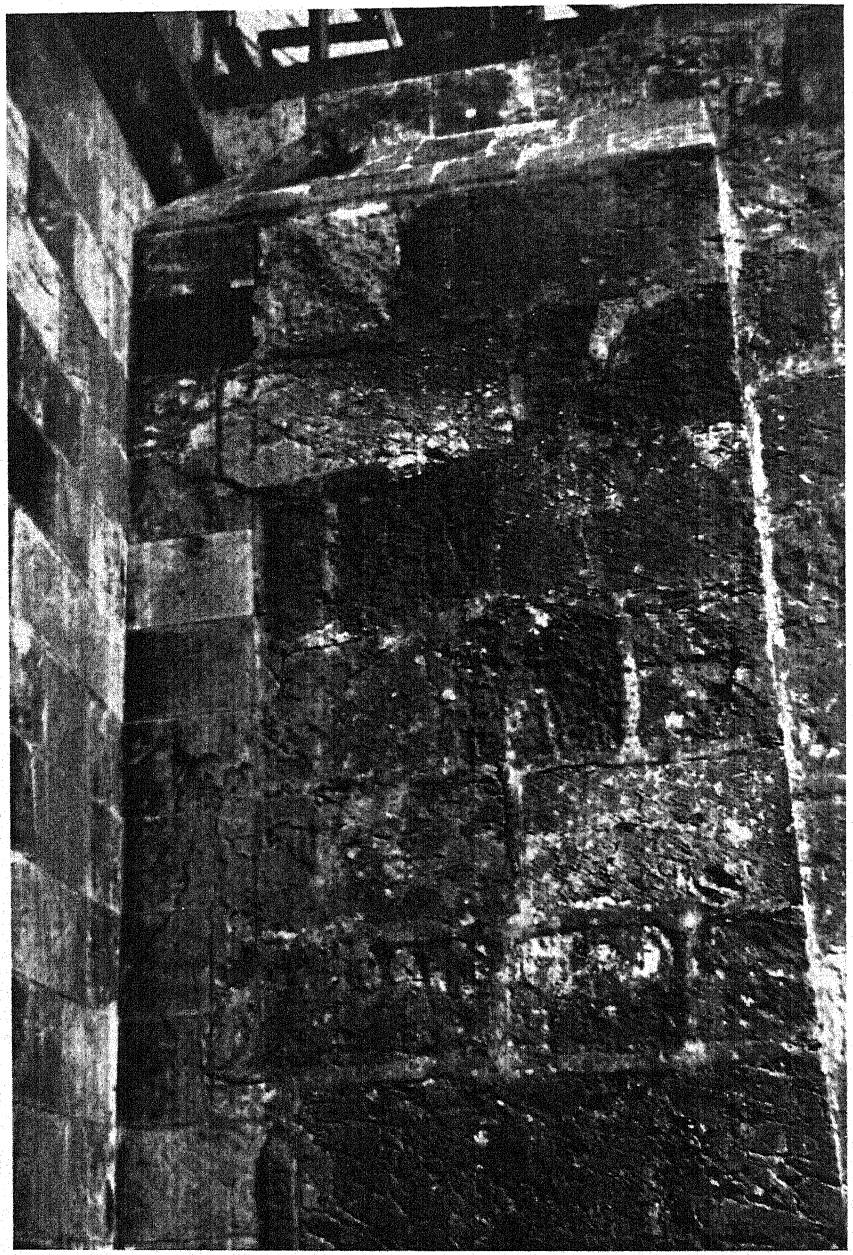
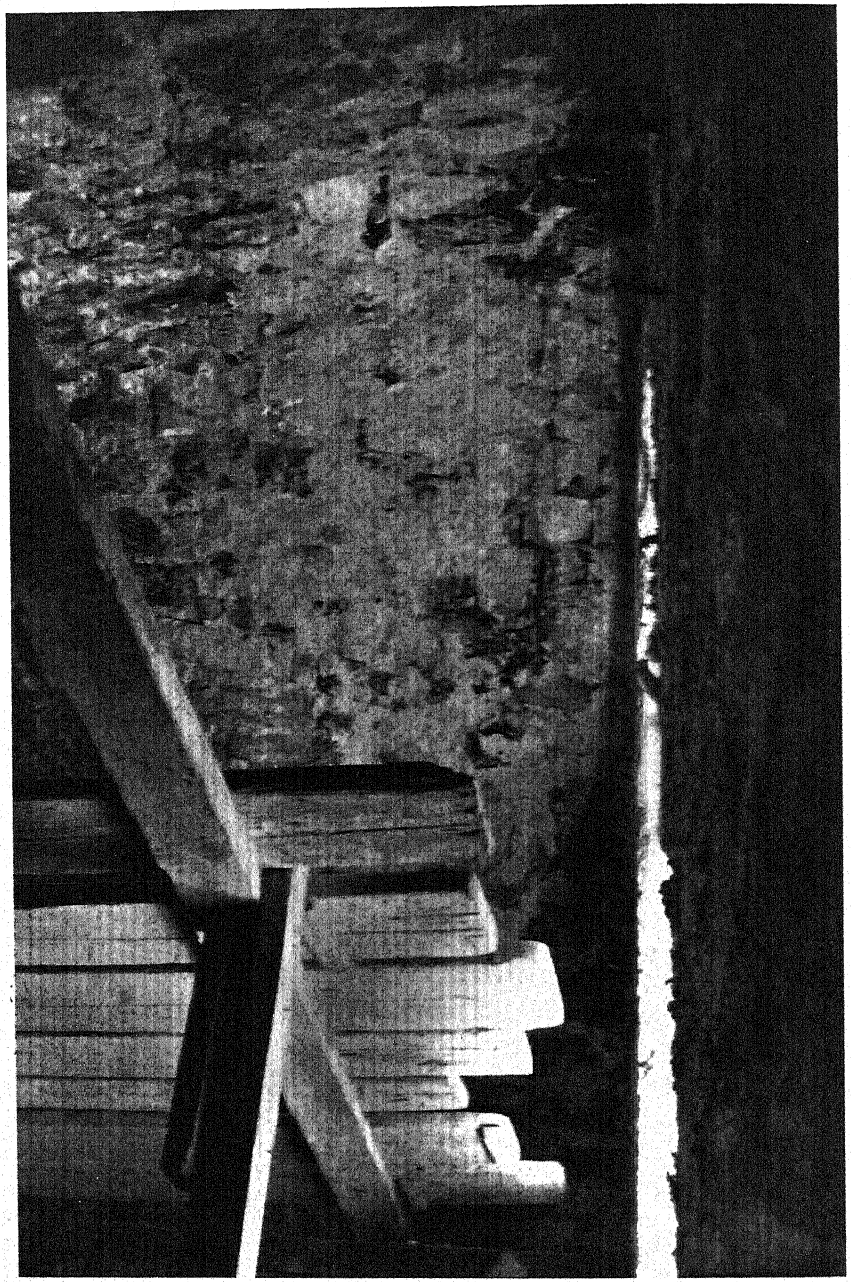


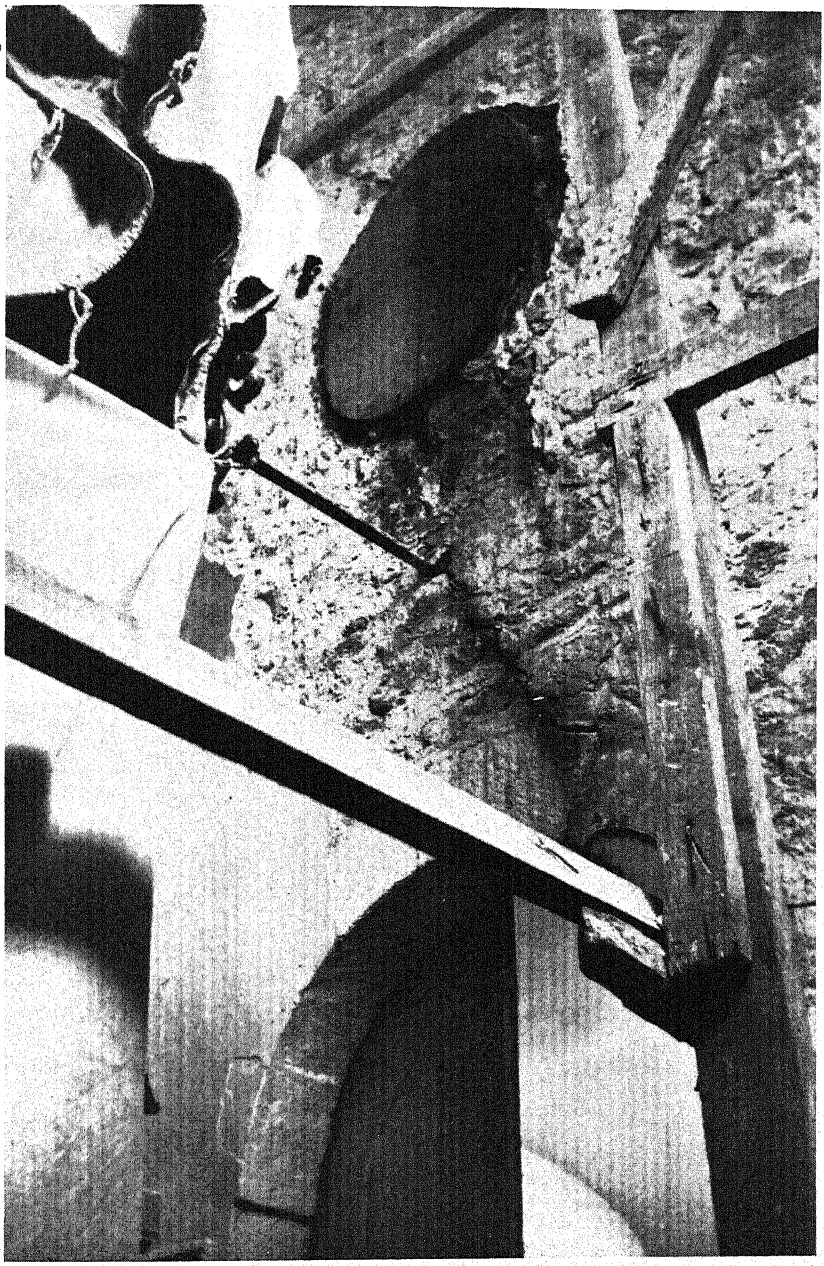
FIG. 36*b*. SOUTH TRANSEPT HIGH VAULT W. WALL TO SHOW CRACK

FIG. 37. FRACTURE IN ATTACHED PIER BETWEEN MAIN DOORS



(Photo. by Antiquities Dept.)

FIG. 38. CRACKED VAULT OF ARMENIAN GALLERY BEFORE RE-PLASTERING



(Photo. by Antiquities Dept.)

FIG. 38*a*. CRACK IN TRANSVERSE WALL OF ARMENIAN GALLERY BEFORE RE-PLASTERING

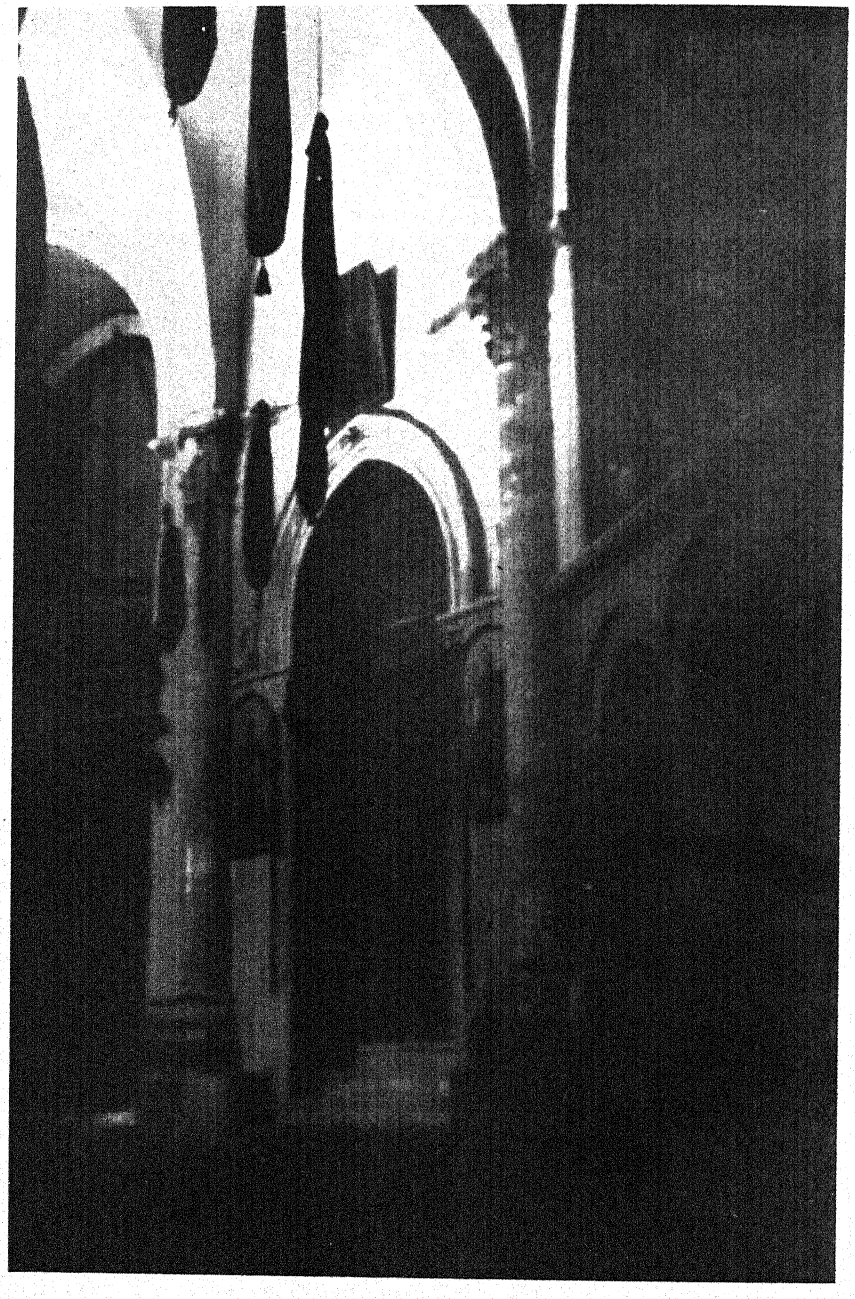


FIG. 39. AMBULATORY LOOKING N.

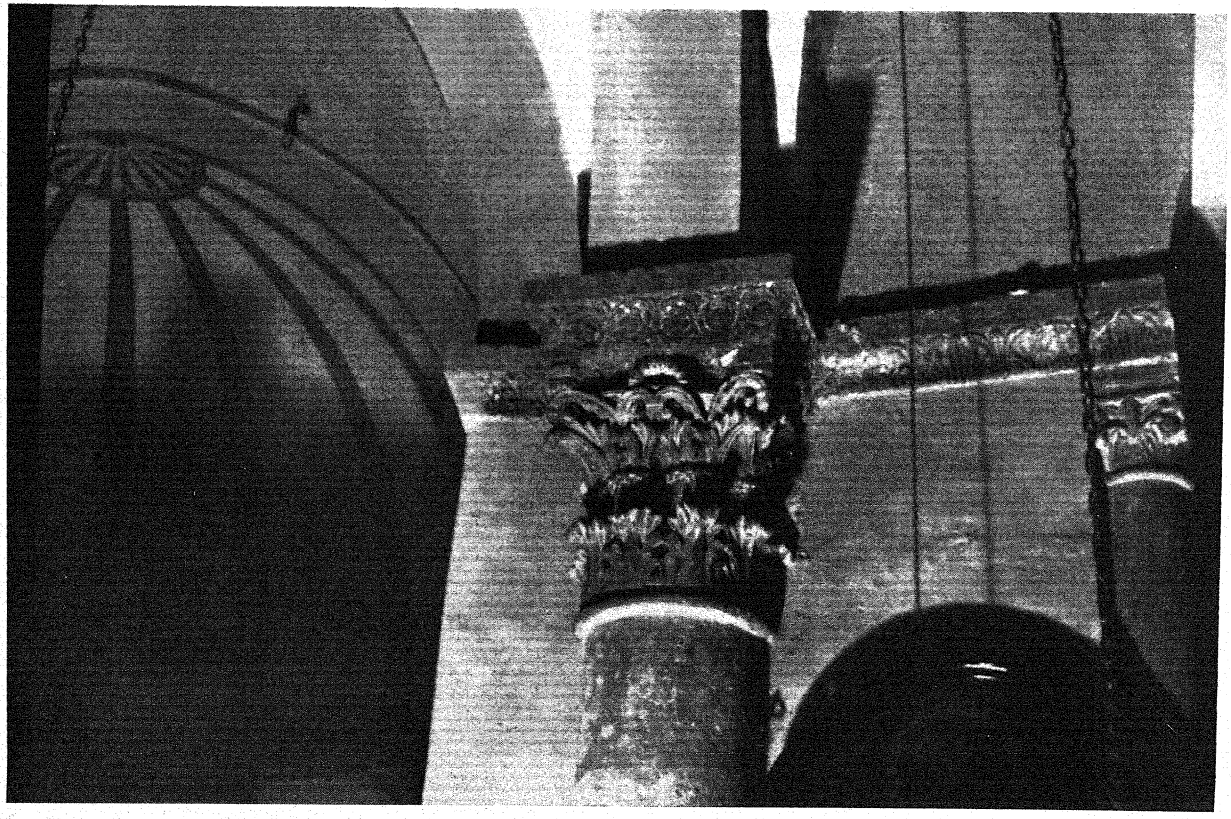


FIG. 40. CAPITAL IN AMBULATORY OUTER WALL

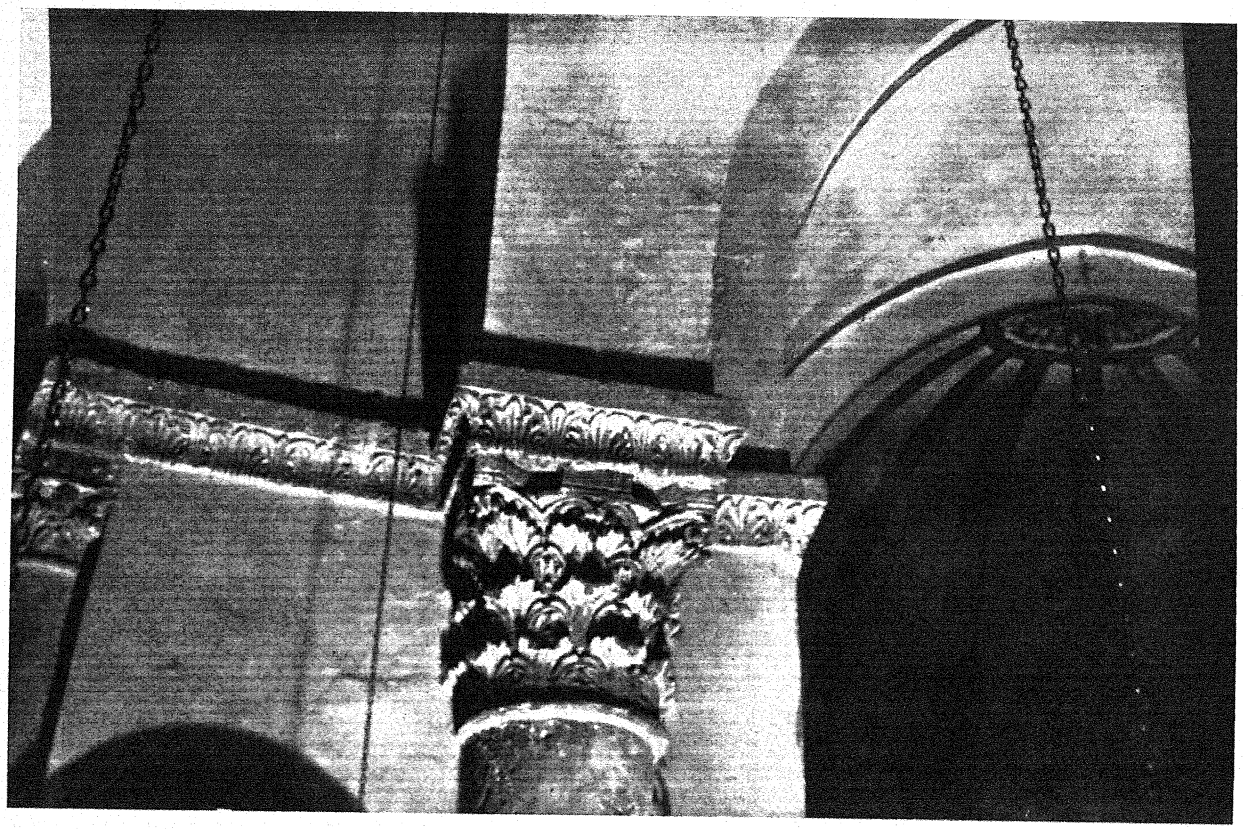


FIG. 41. CAPITAL IN AMBULATORY OUTER WALL

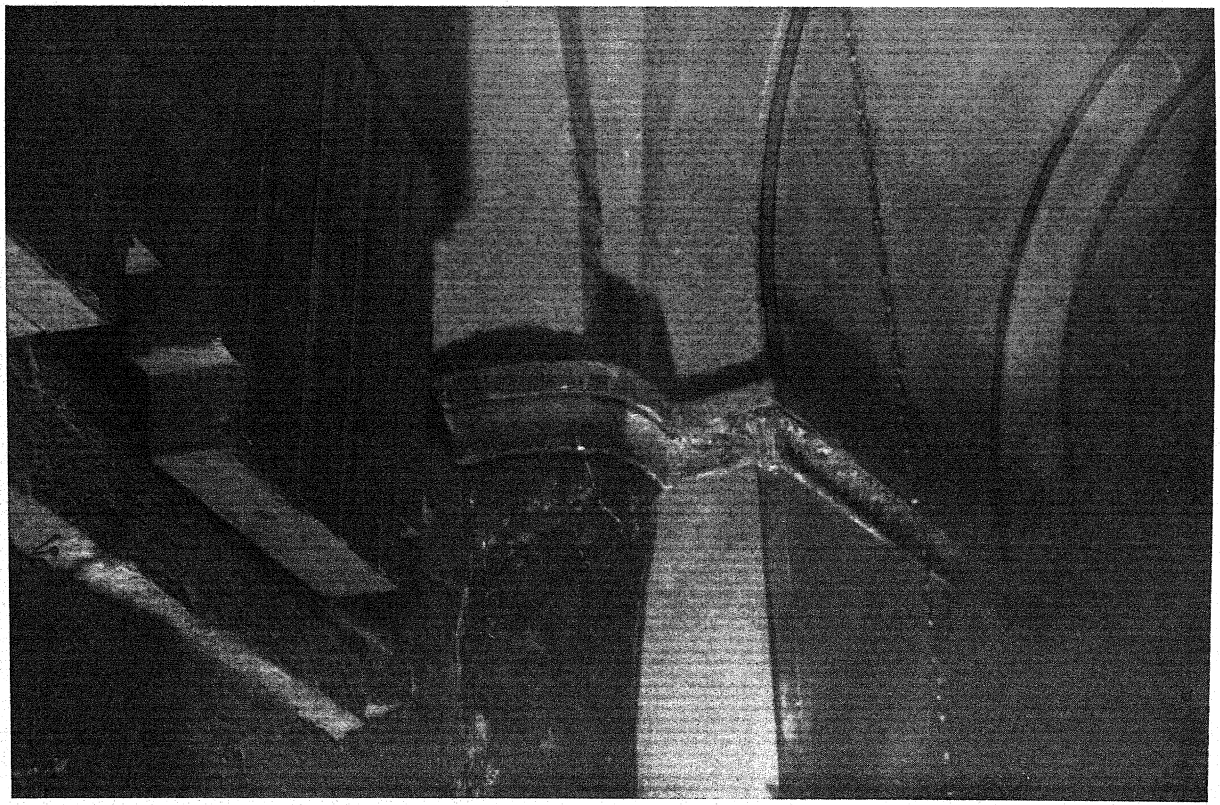


FIG. 42. CAPITAL DESTROYED BY 'RESTORATION' OF 1810. AMBULATORY

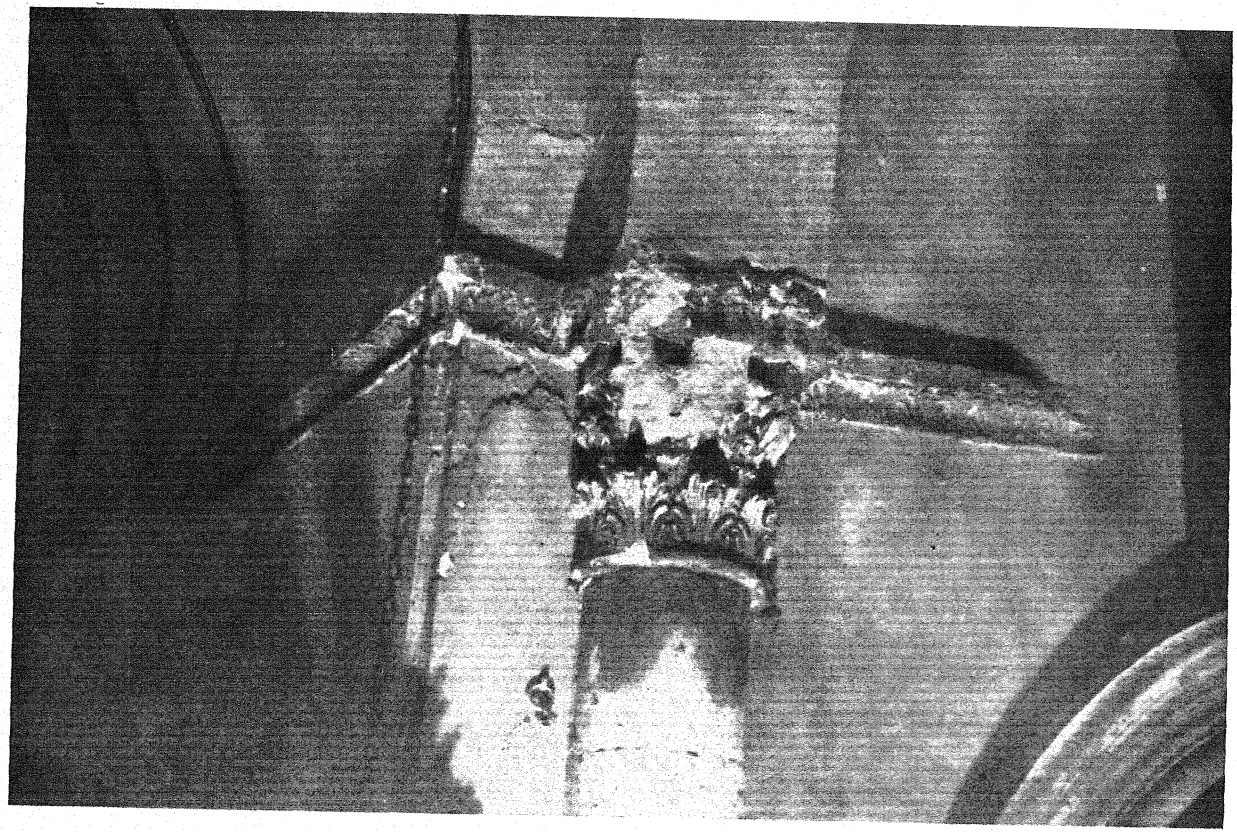


FIG. 43. CAPITAL DAMAGED RECENTLY. AMBULATORY

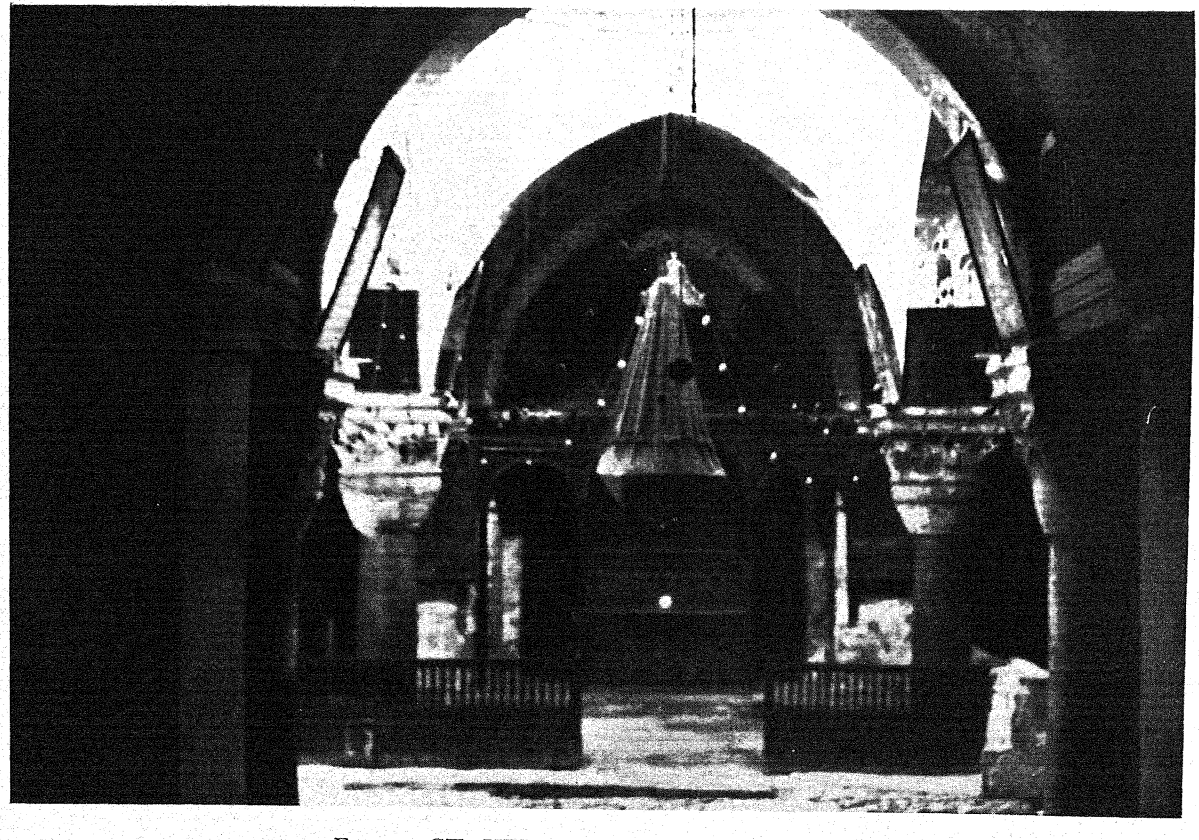


FIG. 44. ST. HELENA'S CHAPEL FROM W.

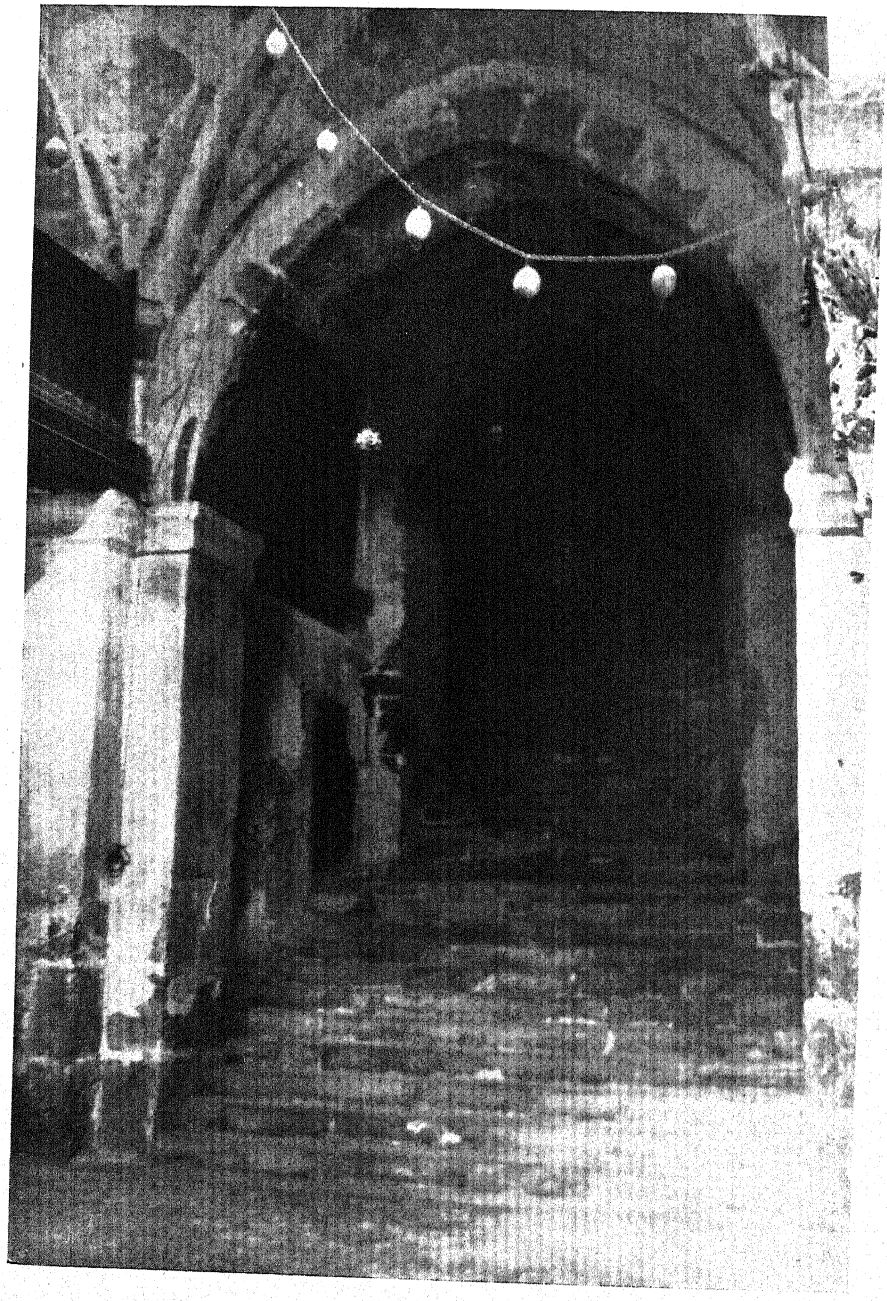


FIG. 45. STAIRS TO ST. HELENA'S CHAPEL

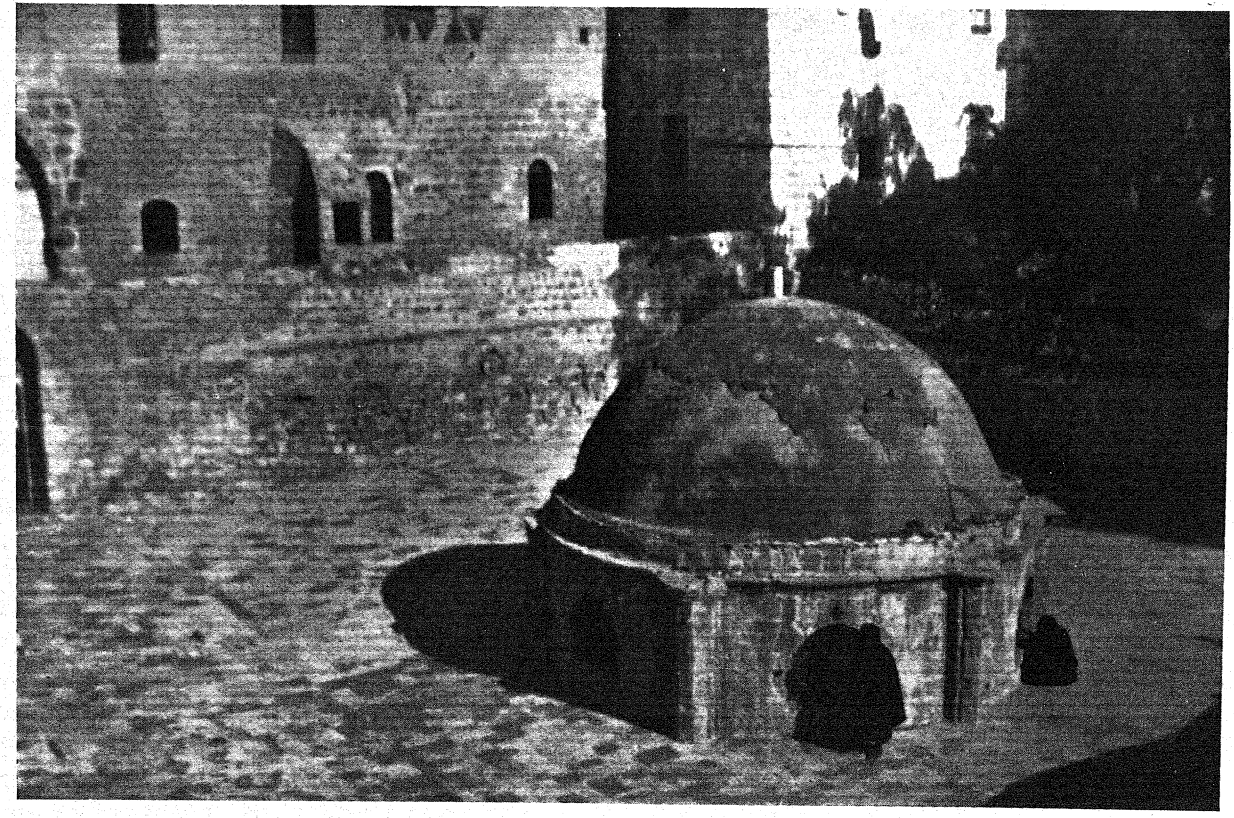


FIG. 46. DOME OF ST. HELENA'S CHAPEL

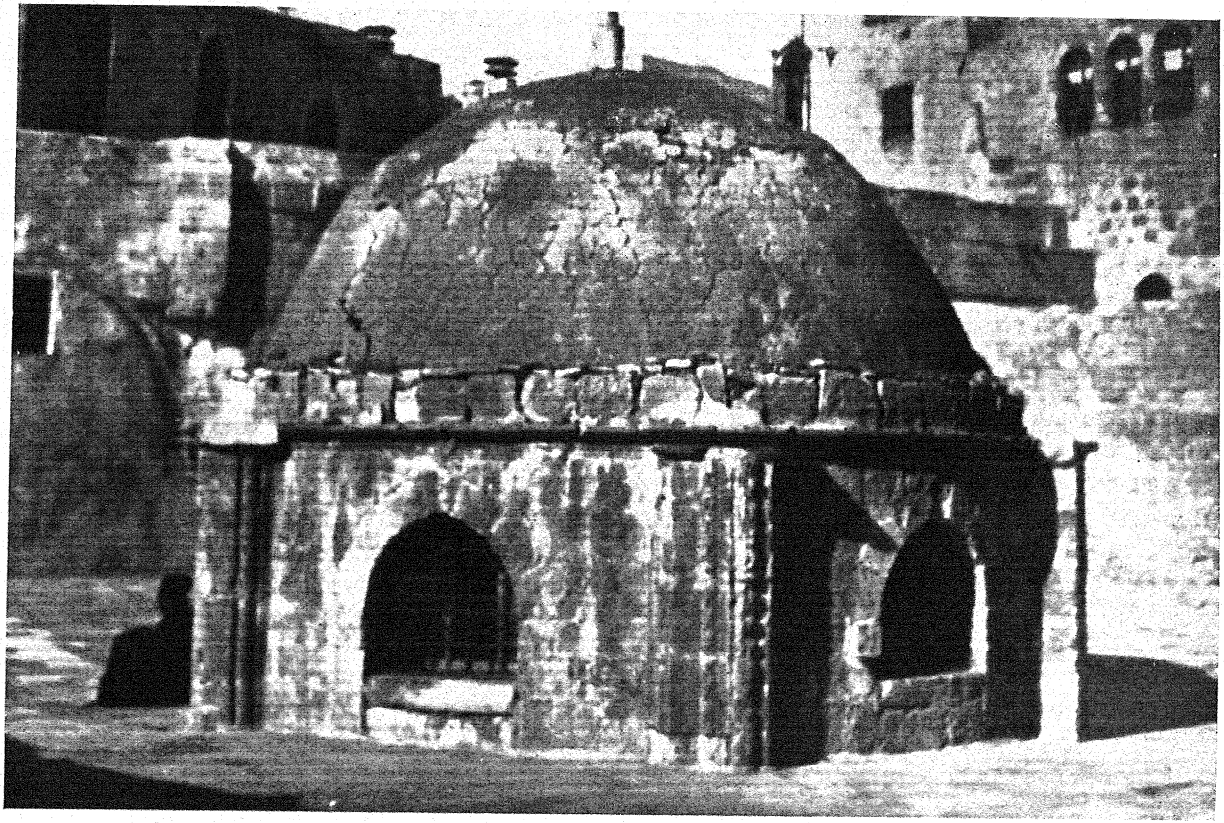


FIG. 47. DOME OF ST. HELENA'S CHAPEL FROM S.E.

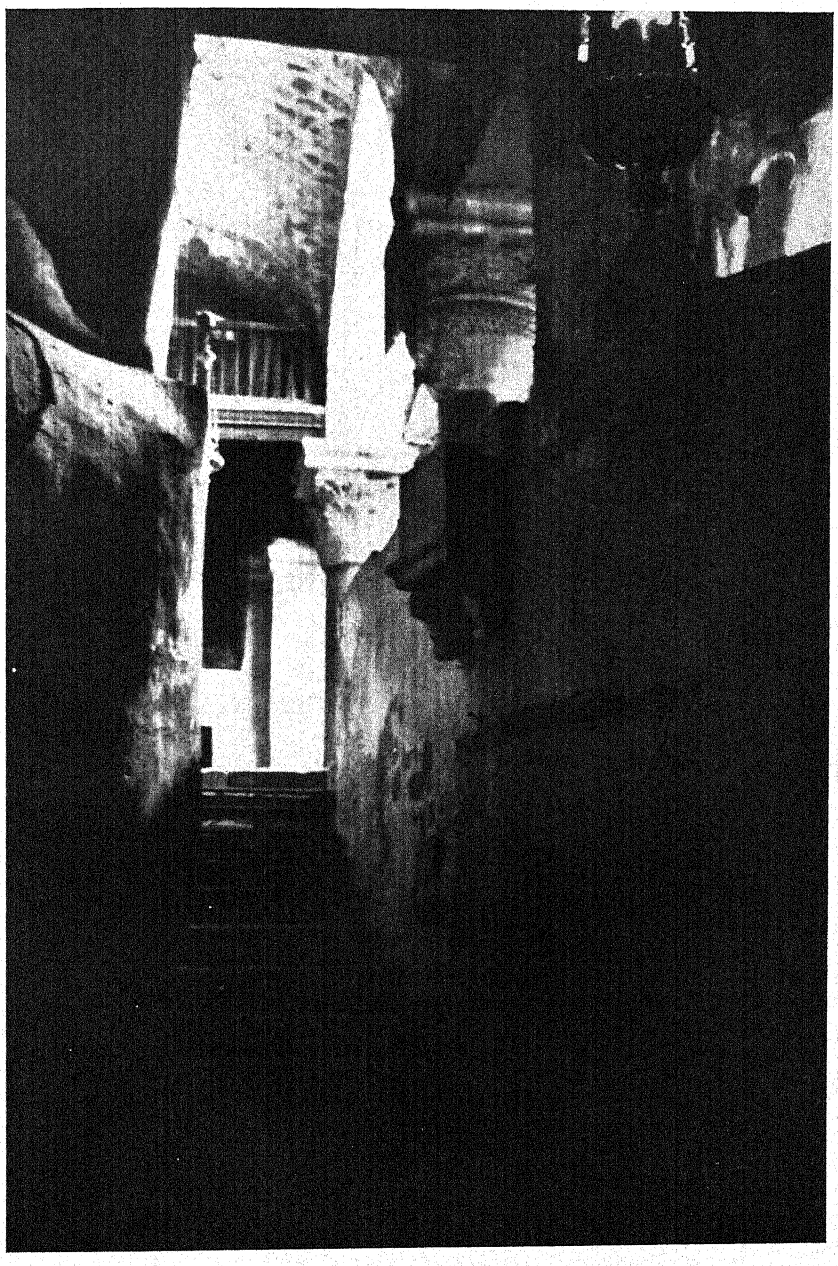


FIG. 48. STAIR TO GROTTO OF THE INVENTION

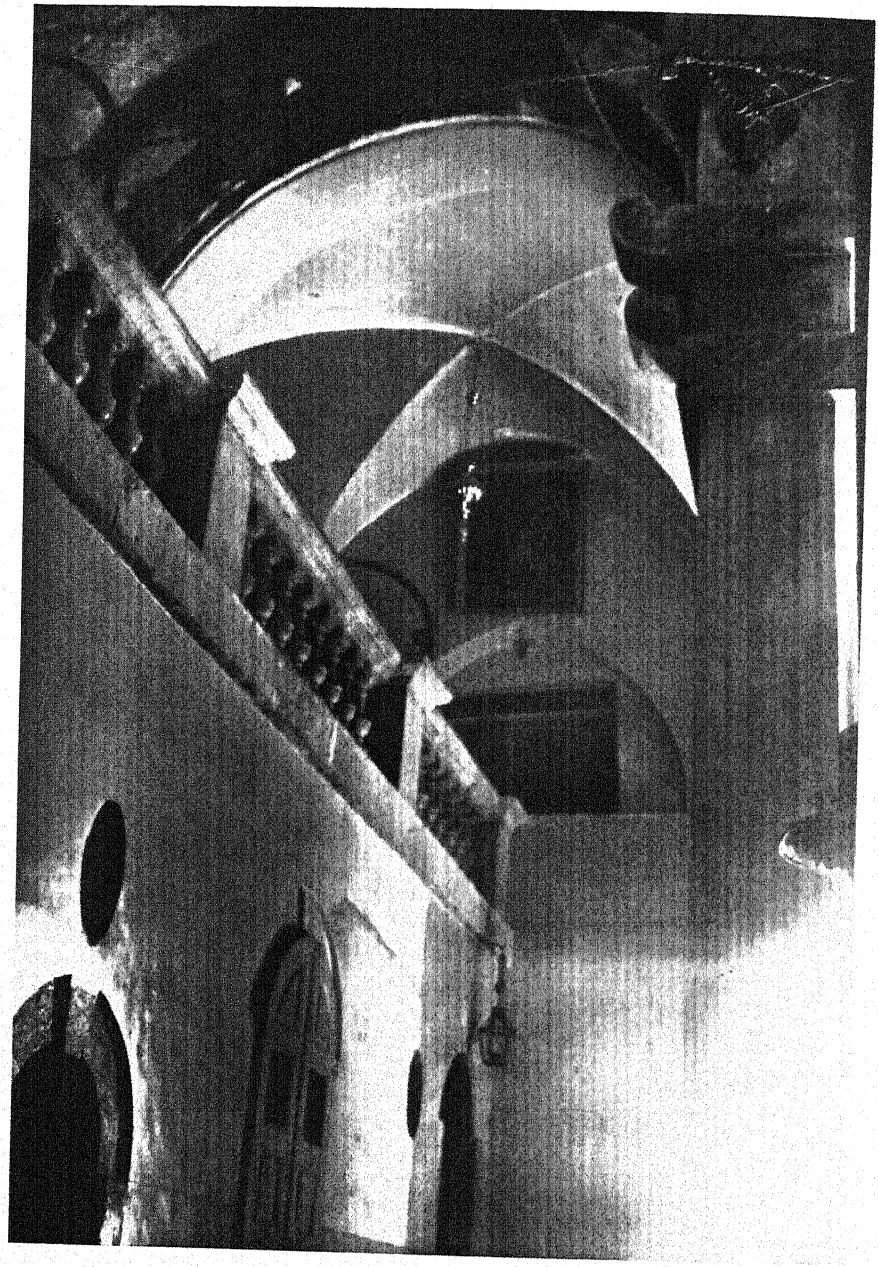


FIG. 49. WORK OF 1810 BENEATH CALVARIES

FIG. 50. CHAPEL OF THE FRANKS

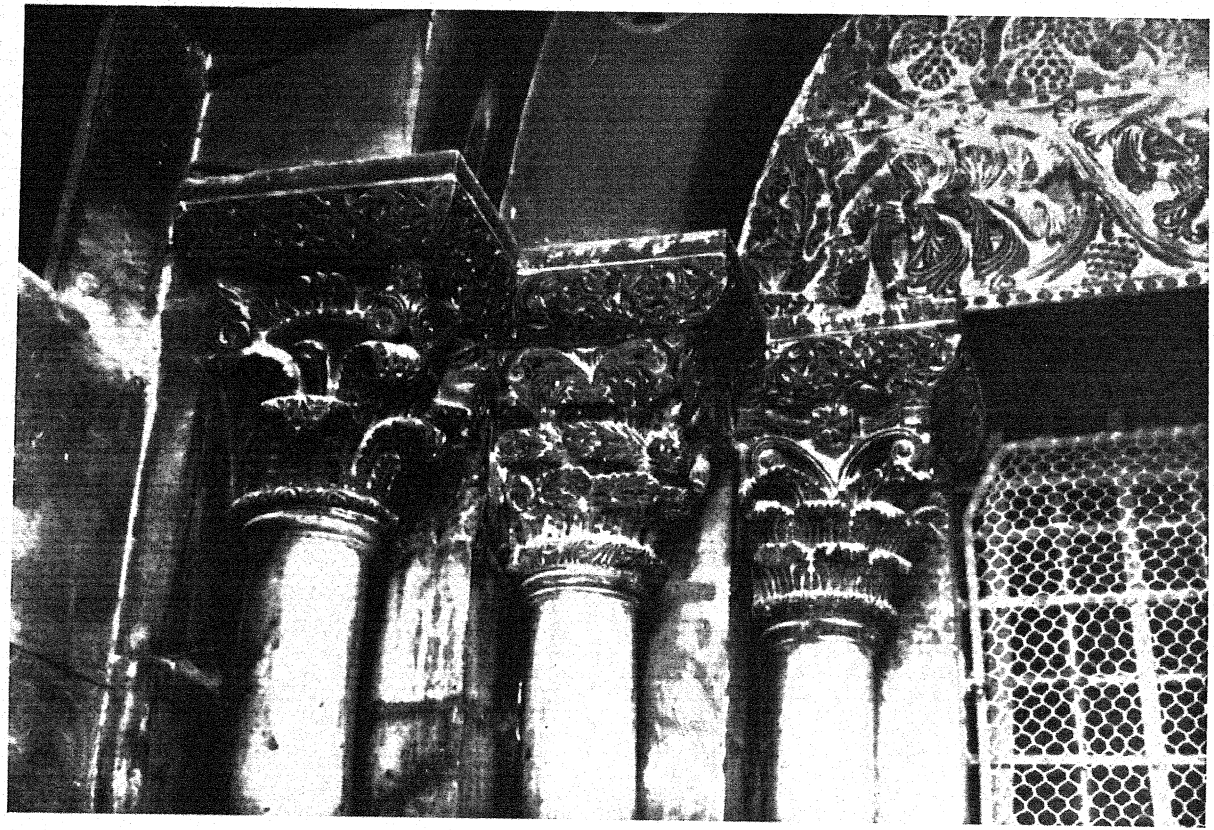


FIG. 51. CAPITALS OF OLD DOOR TO CALVARY

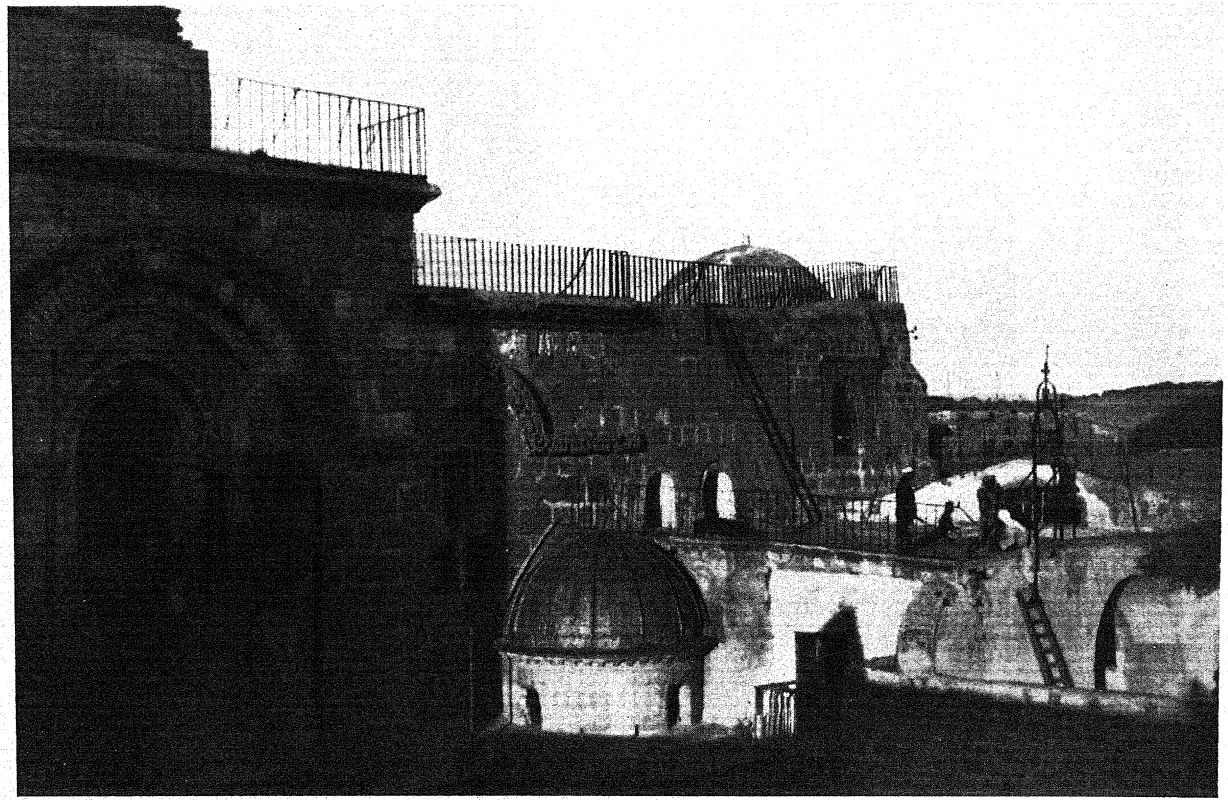


FIG. 52. SOUTH-EASTERN ANGLE OF BUILDINGS, WITH CHAPEL OF MELCHIZEDEK TOWARDS RIGHT

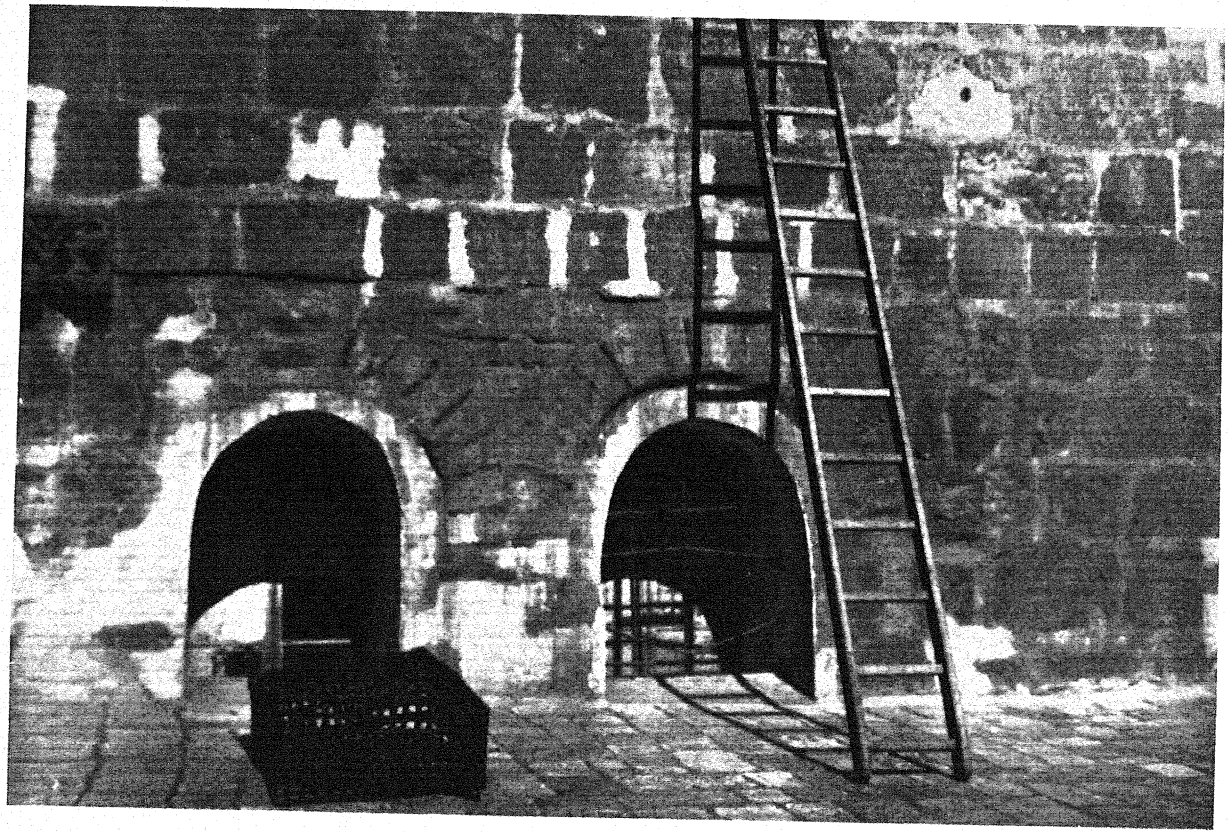


FIG. 53. WINDOWS OF CHAPEL OF MELCHIZEDEK

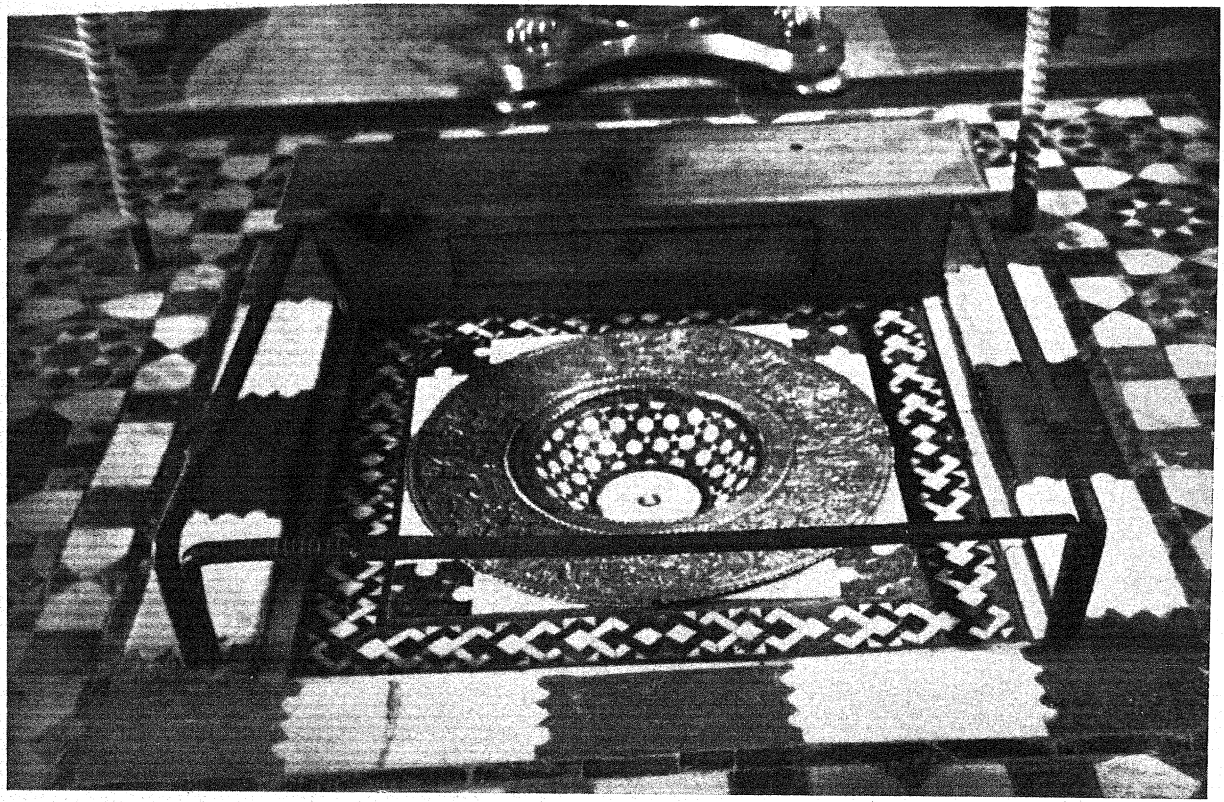


FIG. 54. PAVEMENT IN CHAPEL OF MELCHIZEDEK

FIG. 55. NORTH WALL OF OLD REFECTORY—NOW CHAPEL

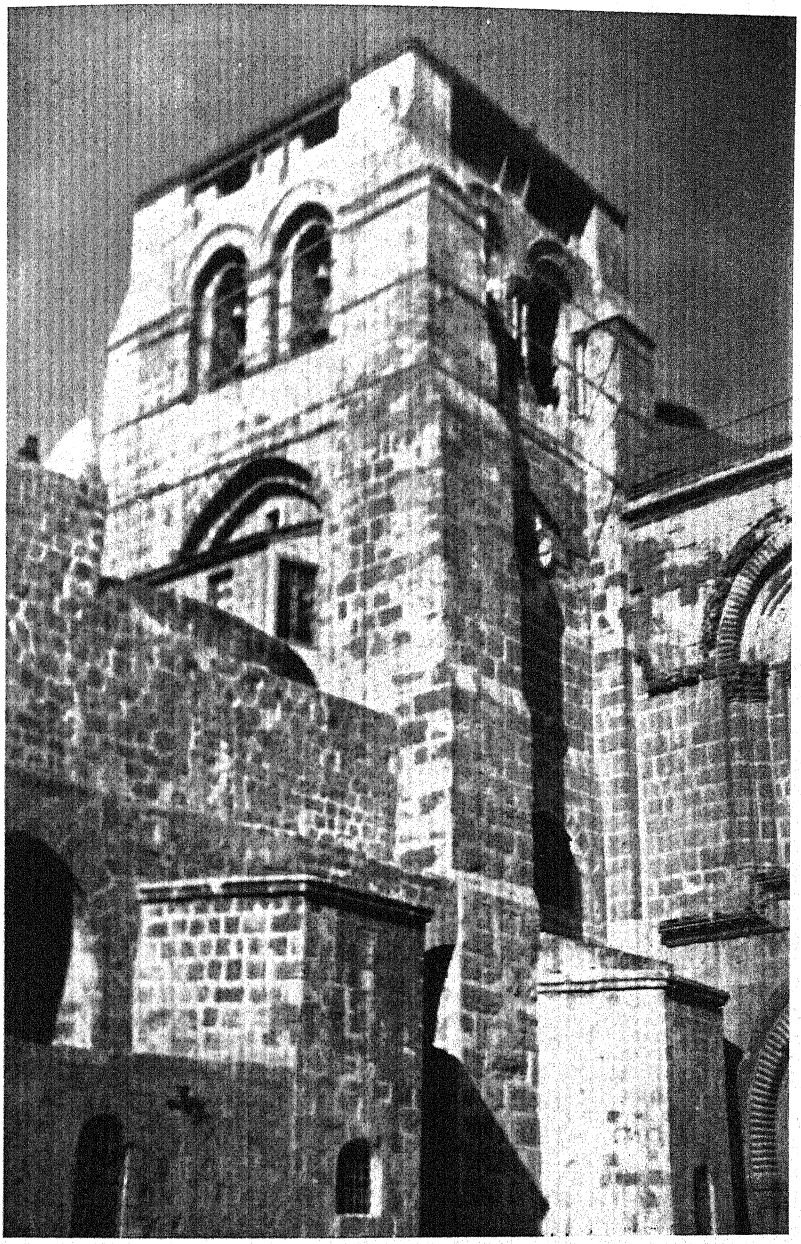


FIG. 56. TOWER FROM S.E.

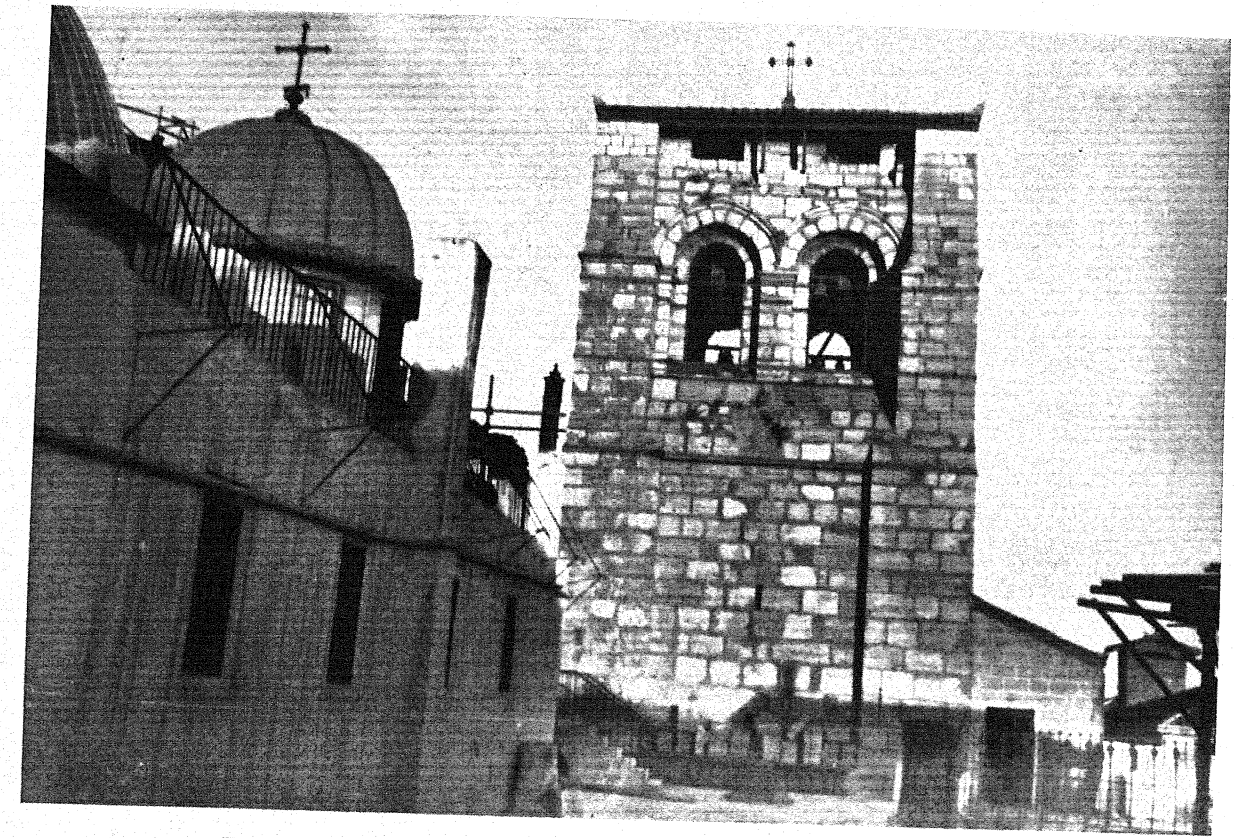


FIG. 57. TOWER FROM W. AND CHAPEL OF CONSTANTINE

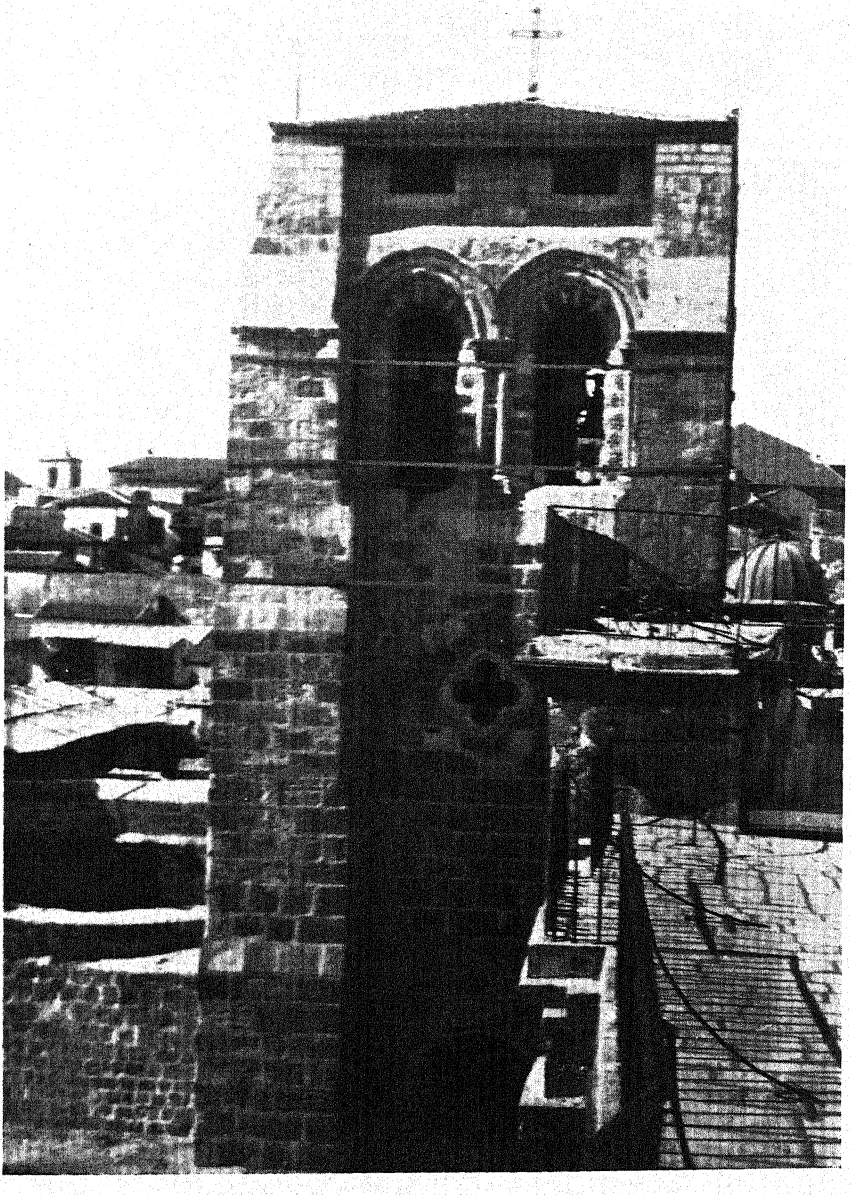


FIG. 58. TOWER FROM E.

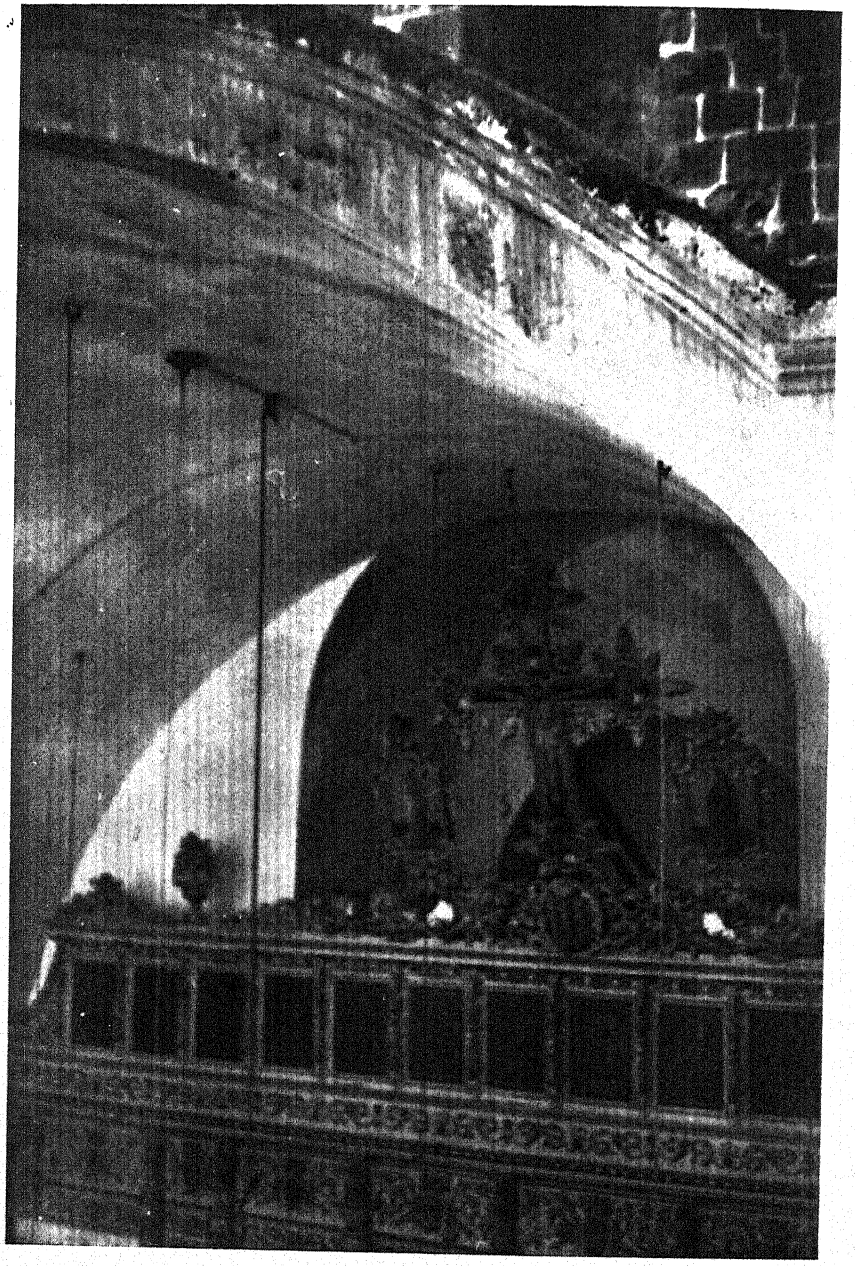


FIG. 59. VAULT OVER OLD BAPTISTERY

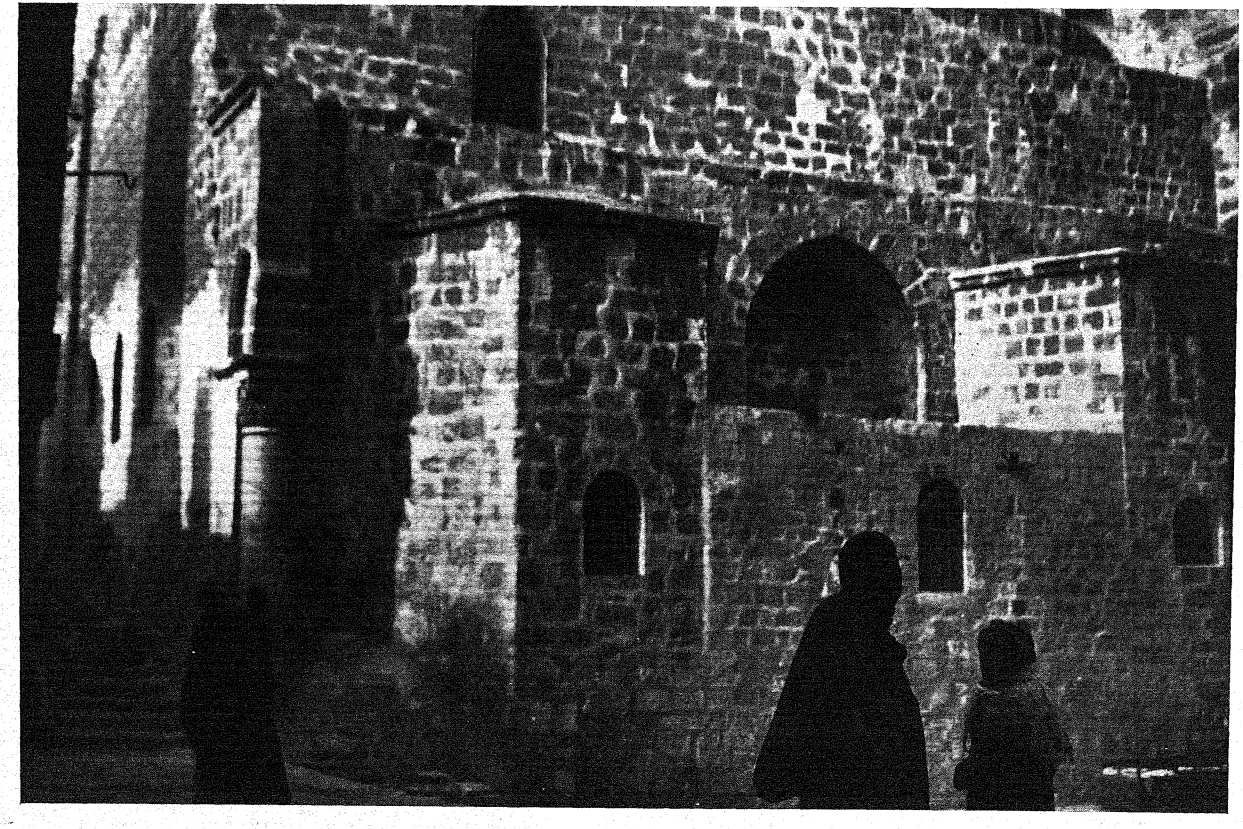


FIG. 60. WEST SIDE OF PARVIS WITH COLUMN OF RUINED ARCADE, AND APSES OF CHAPEL OF ST. JAMES AND BAPTISTERY

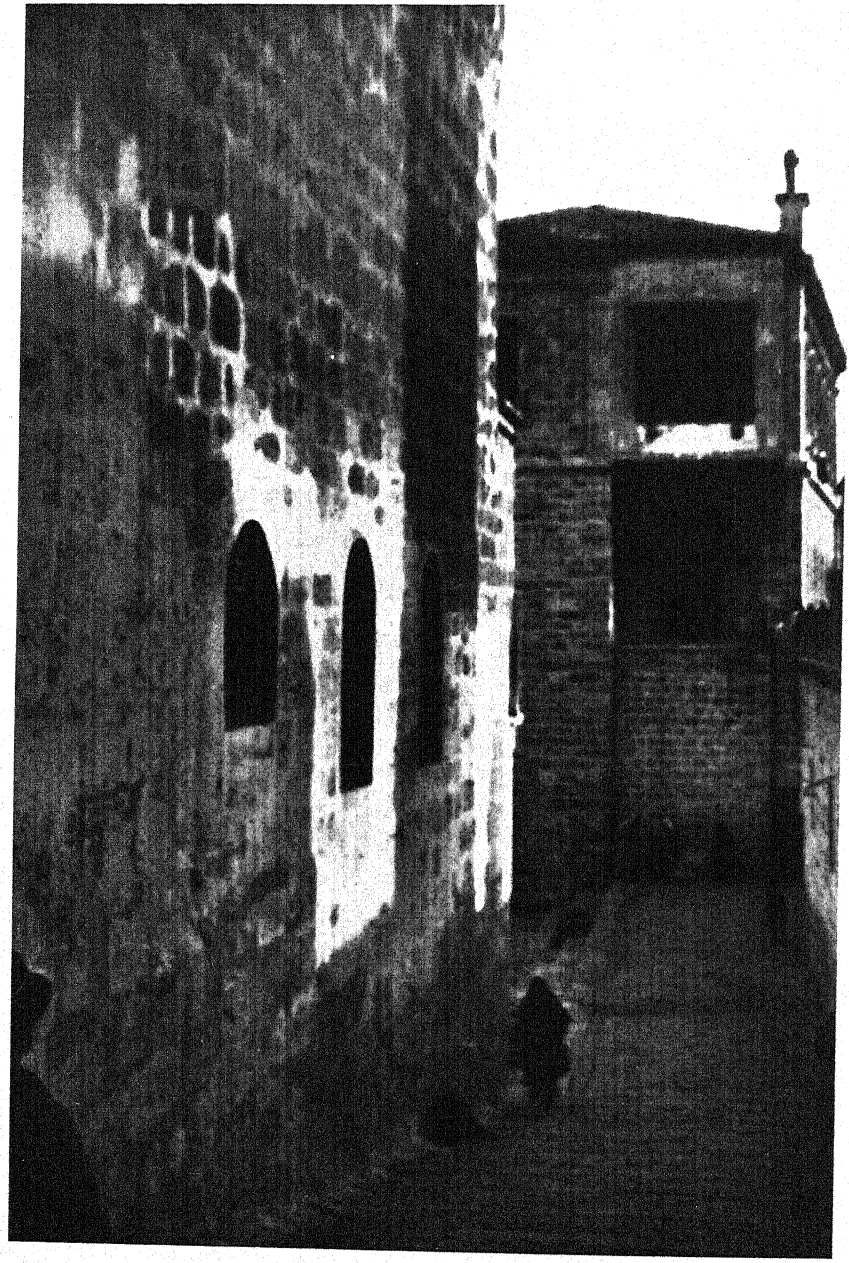


FIG. 61. SOUTH WALL OF CHAPEL OF ST. JAMES

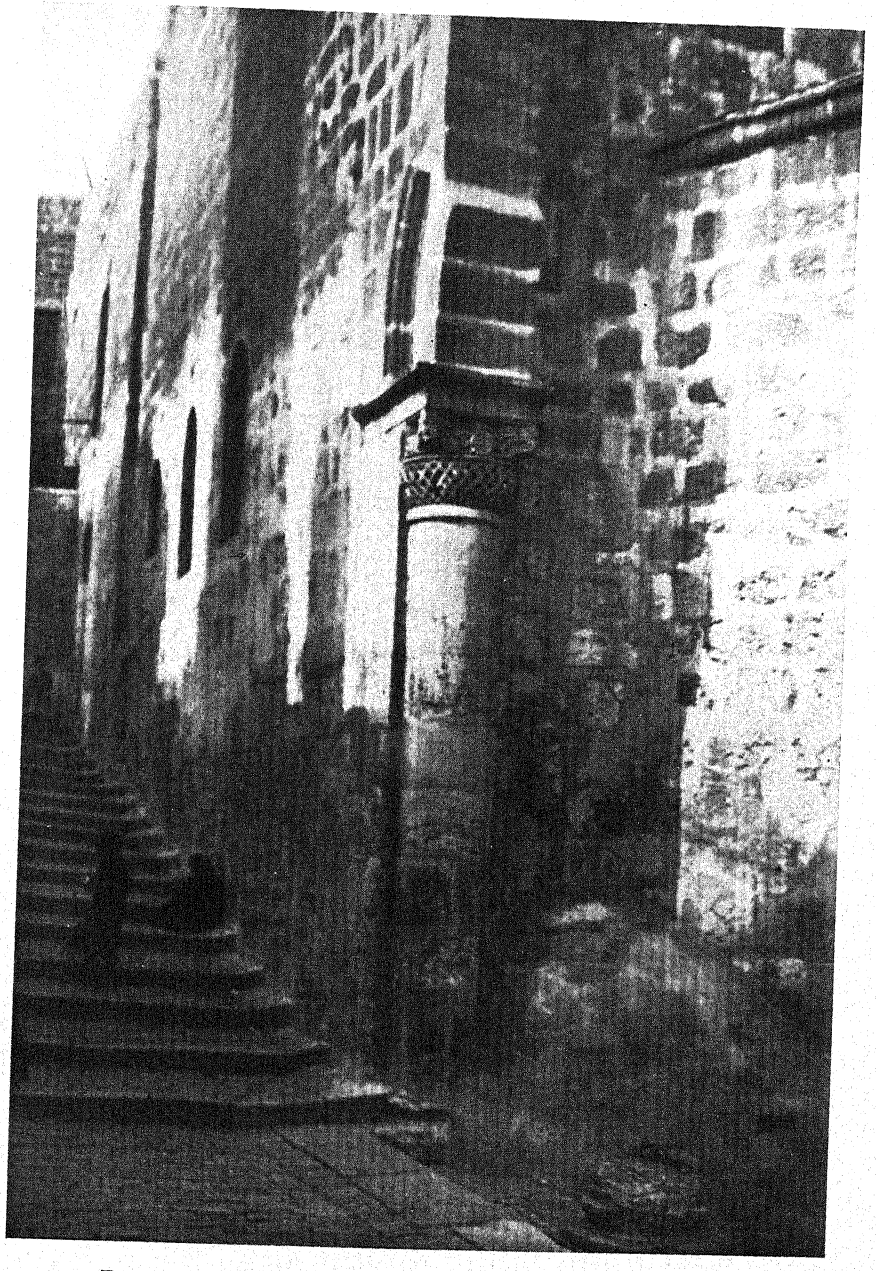


FIG. 62. SOUTH WALL OF CHAPEL OF ST. JAMES

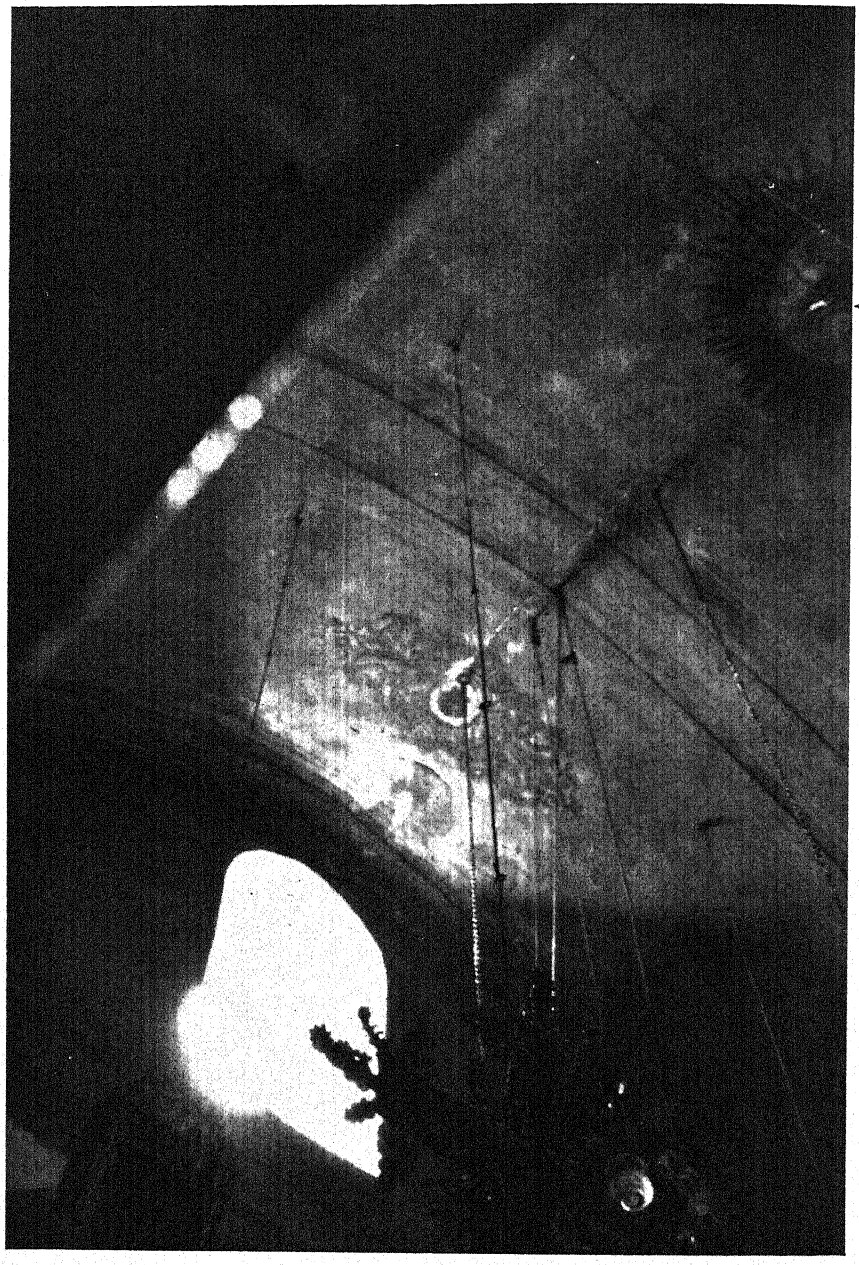


FIG. 63. VAULT OF CHAPEL OF ST. JAMES

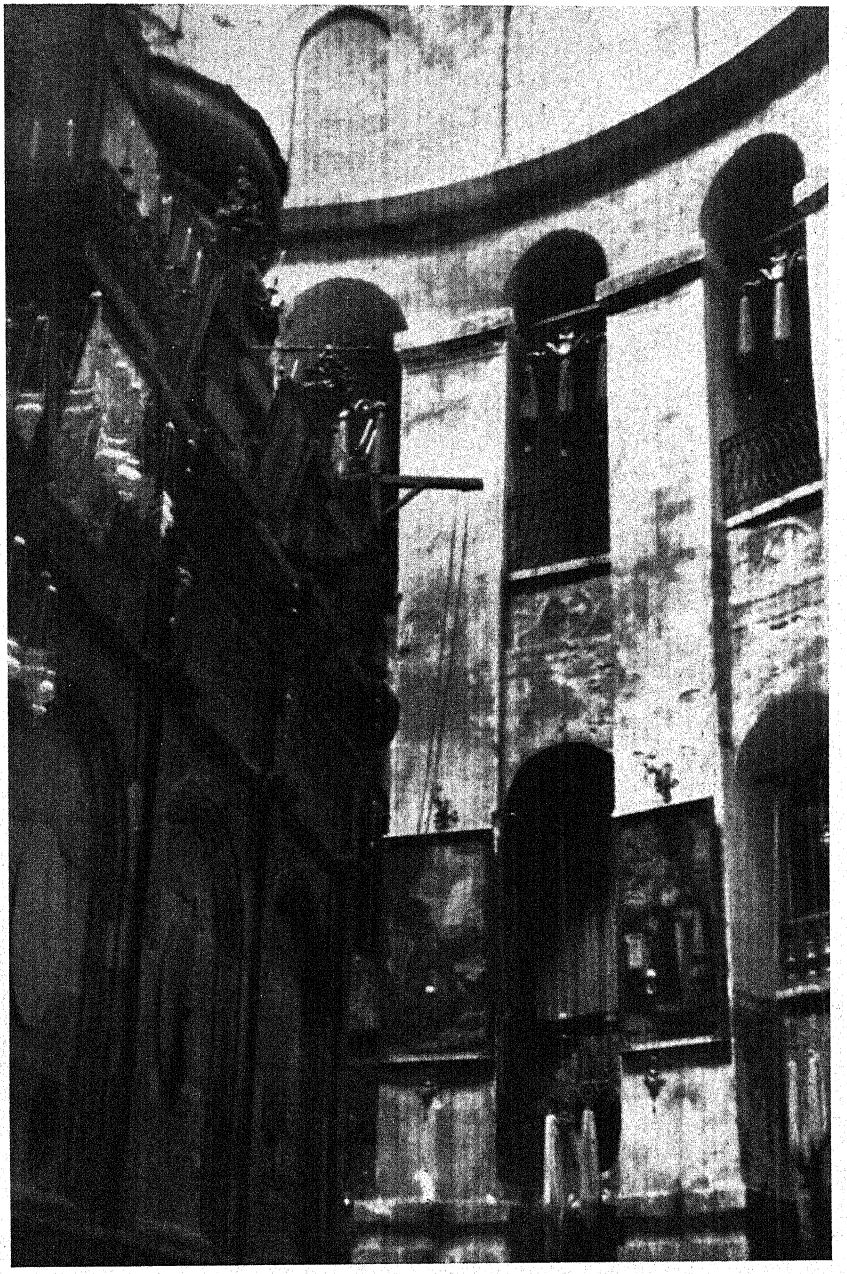


FIG. 64. NORTH-WEST PART OF ROTUNDA

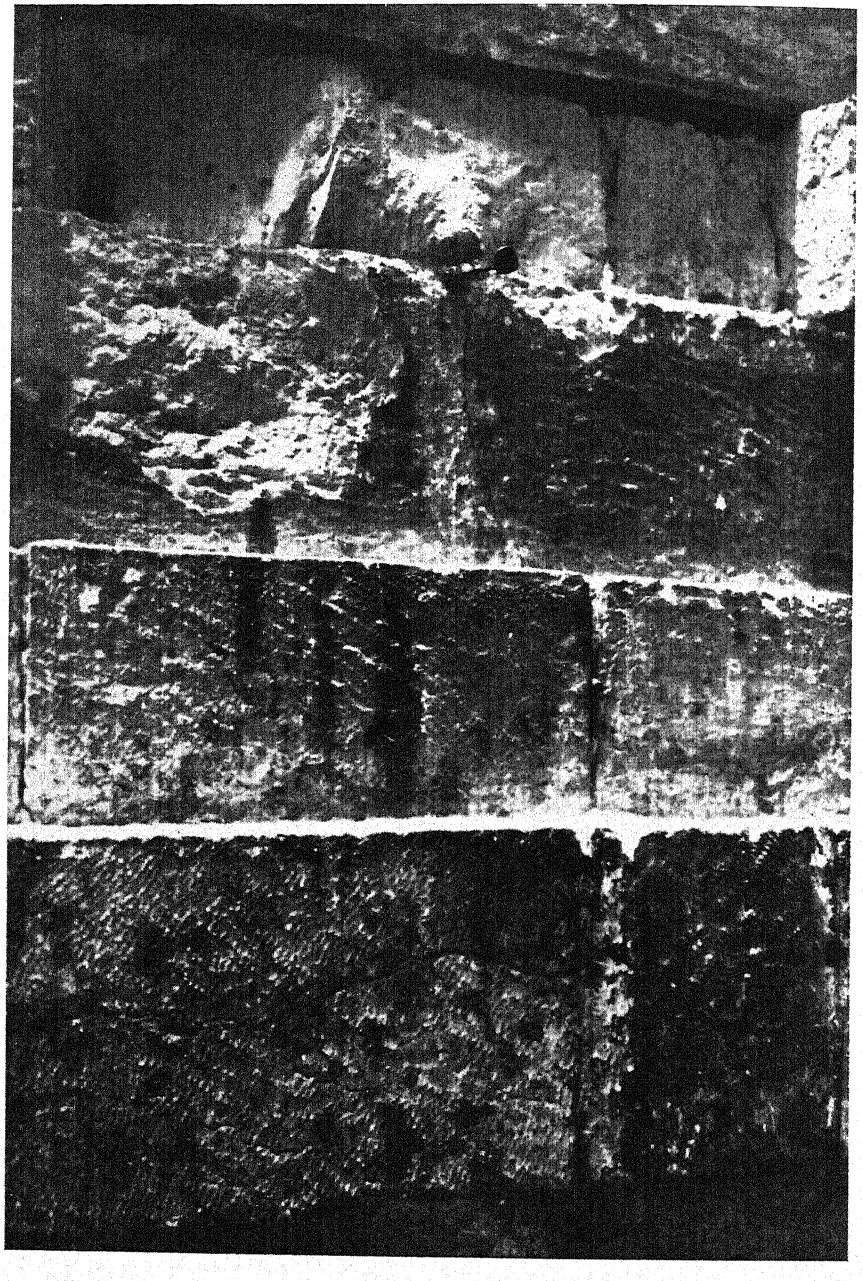


FIG. 65. FRACTURES DUE TO RUSTING IRON CRAMPS.
ROTUNDA PIERS

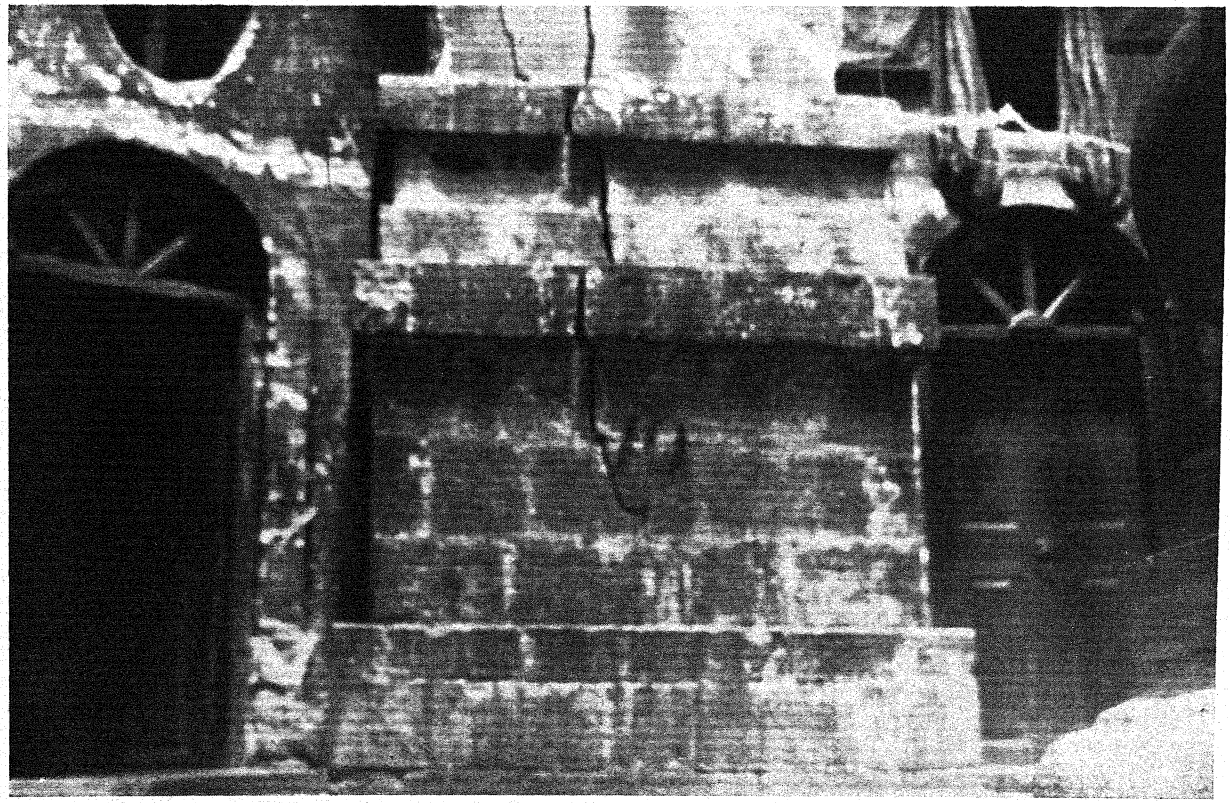


FIG. 66. FRACTURED PIER AT W. OF ROTUNDA

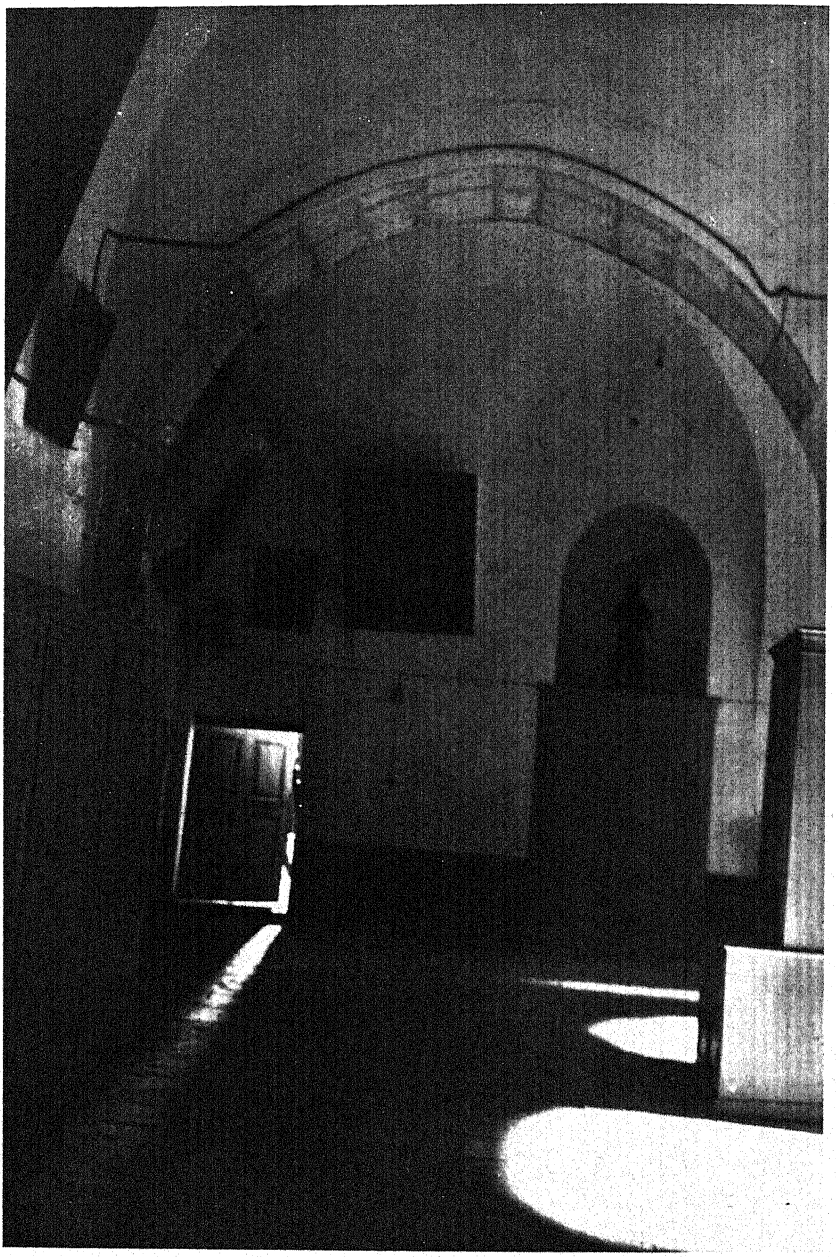


FIG. 67. FRANCISCAN UPPER GALLERY OF ROTUNDA

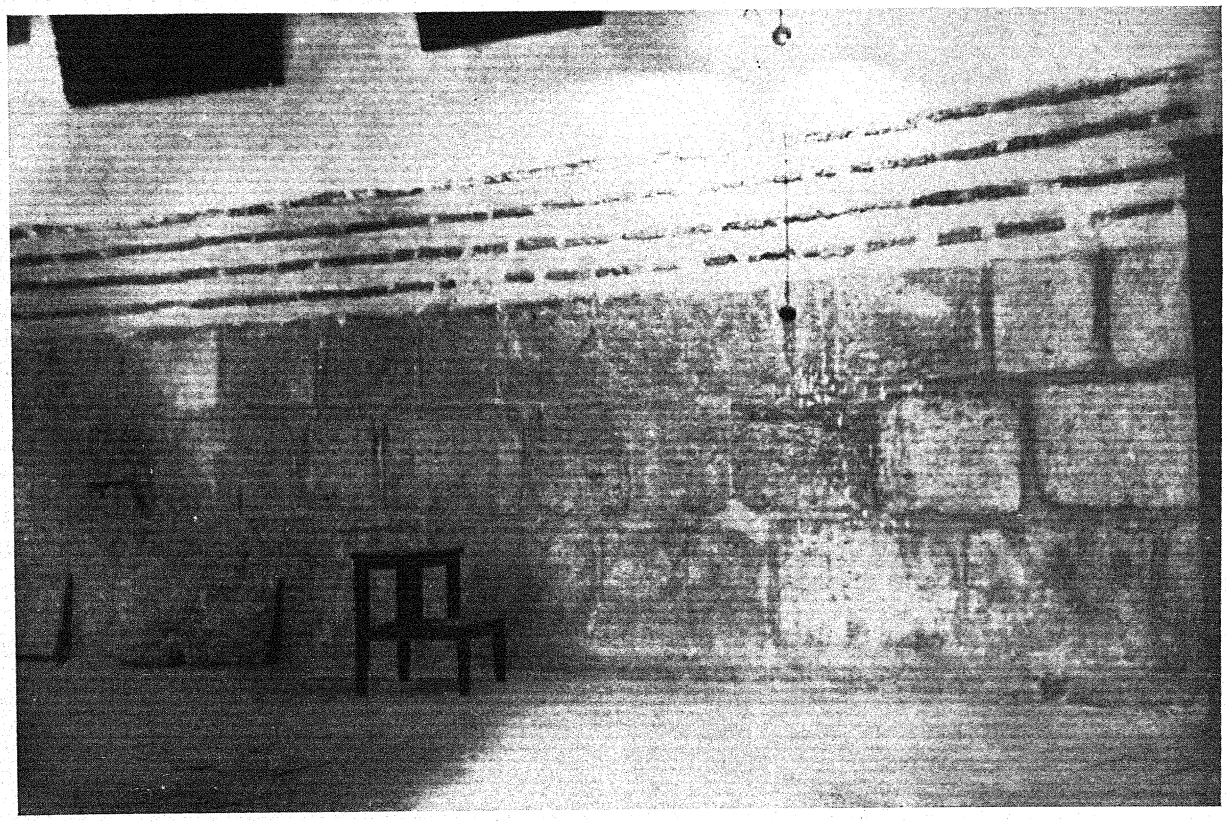


FIG. 68. BYZANTINE OUTER WALL OF ROTUNDA IN UPPER GALLERY

(*Photo. by Antiquities Dept.*)

FIG. 69. PORTION OF HIGH VAULT ROOF, SHOWING SUPERIMPOSED LEVELS OF SLABS

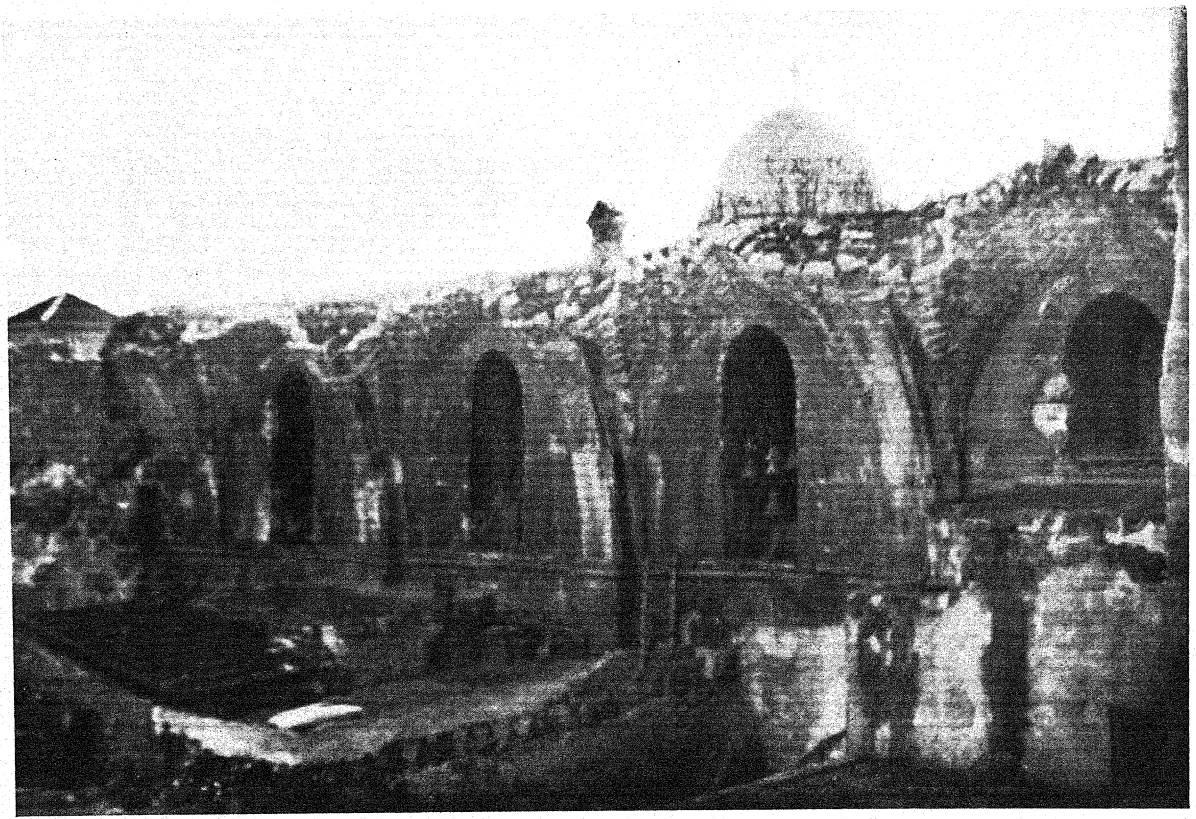


FIG. 70. RUINED SOUTH WALL OF OLD REFECTORY

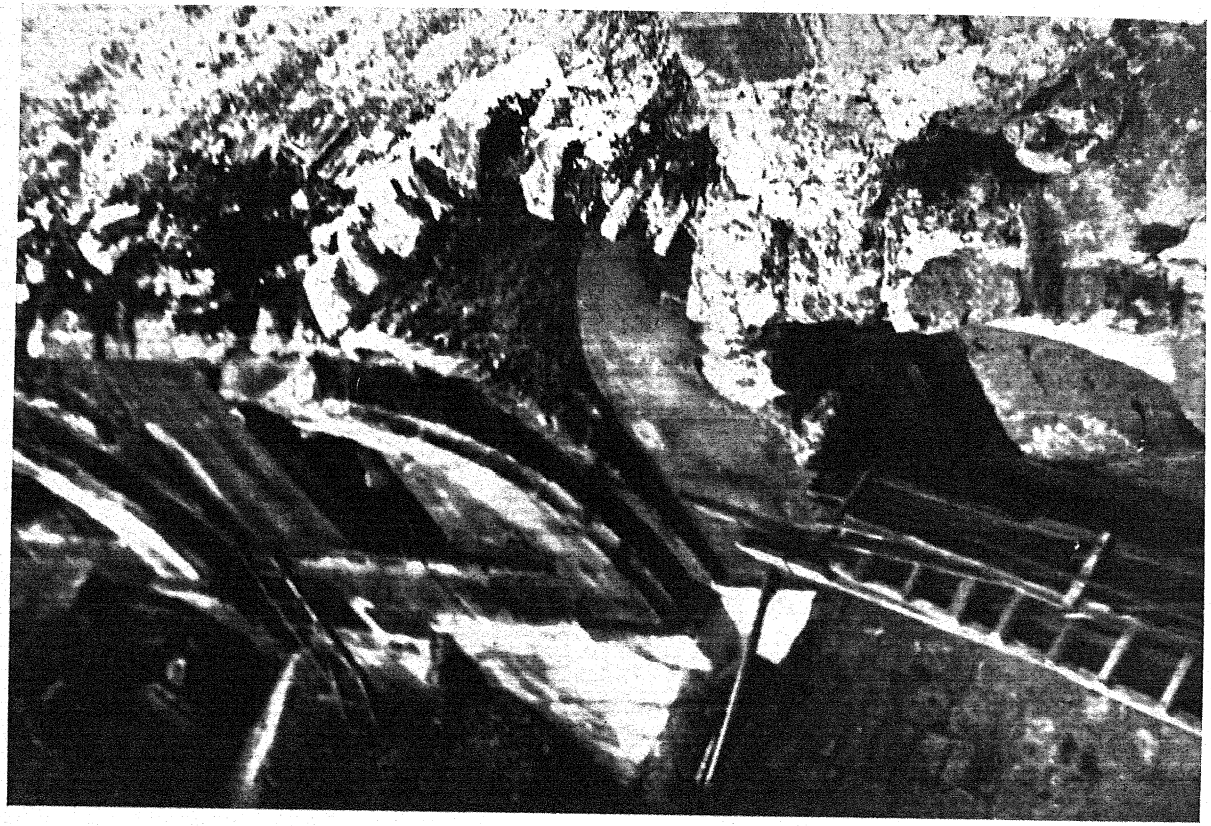


FIG. 71. OVERHANGING VAULT MASSES OF OLD REFECTORY

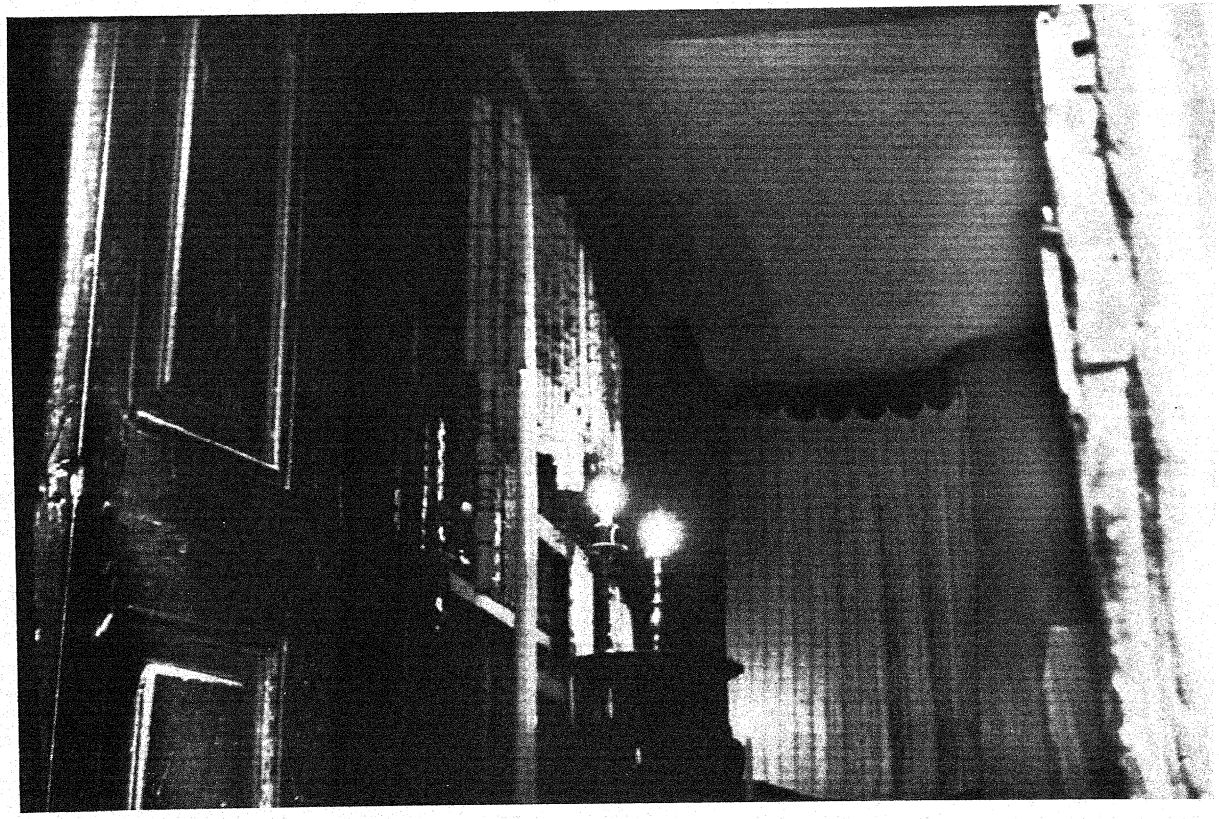


FIG. 72. CANDLE STORE IN OLD AISLE OF ROTUNDA

PART II

MEASURES OF PERMANENT REPAIR NECESSARY FOR CONSERVATION

It has been shown in the first part of this report that the principal cause of decay in the Church of the Holy Sepulchre is the unbalanced nature of the thrusts from the dome over the Katholikon, and that other thrusts in various parts of the building have aided these in forcing all the external parts of the fabric outwards. Subsidiary troubles are the poor quality of the joints in many places, and the overloading of the stone, which is being crushed by the great weight from above.

All repairs to monuments of historic interest should as far as possible be concealed, the original work being left untouched as far as its external, visible face is concerned; where it is absolutely necessary to insert new material it should harmonize with the earlier work. In this case, all the works of reinforcement will be hidden, with the exception of tie-rods at the springing level of certain of the arches; they will not be obtrusive, and are the least conspicuous method of controlling the outward arch-thrusts. While new stone will have to be inserted wherever the original masonry is calcined or badly fractured, a very large amount of the old work will remain, including almost all the carved decorative features, though on the main front certain of these must be re-carved in new stone.

The work falls under two main heads; in the first place all the important walls and piers require consolidation: this will consist of opening small sections of wall, commencing at the bottom; after washing out all loose remains of the original mortar, a good cement mortar will be poured in, and well pointed on the face joints. In some cases the state of the wall may require the insertion of a reinforced concrete core, a thin layer only of the old stone being replaced on the outside.

The second form of repair to be used consists in the pro-

vision of tensional reinforcement, designed to resist the thrusts, and to keep them from further damaging the building. These reinforcements will be bands of concrete laid in the thickness of the walls, containing stainless steel rods or steel bars of larger section in some instances. They will form continuous circuits wherever possible, and will be well anchored to the main masses of masonry.

As it has not been possible to examine the internal state of the walls, the positions requiring works of consolidation cannot be accurately described, but important areas are as follows.

DESCRIPTION OF REPAIRS

WORKS OF CONSOLIDATION

Grouting of the masonry with good cement mortar, and replacement of badly fractured stones will be necessary in several parts of the building, beginning from the bottom in each case.

The piers, both of the Katholikon and of the Rotunda must be so treated, and in the latter case it may be possible to reveal or rebuild the earlier Byzantine piers which carried the dome until 1808.

The South Transept wall, which forms the main front of the Church, must also be grouted, and much new stone will have to be inserted in its upper part. Where carved work is too much decayed to be replaced, copies should be made in similar new stone, by selected masons. The cornice and parapet need complete rebedding, though most of the old stone can be retained.

The upper parts of the North Transept wall also require similar treatment, while the exterior wall of the main apse is so fractured by rusting ironwork that a complete rebuilding from the level of the ambulatory vault seems necessary.

Finally, the pendentives, on which the Katholikon drum rests, must be carefully grouted until their stability is assured.

The whole of this consolidation work must be carried out in conjunction with the insertion of tensile reinforcements, which will now be described.

Particular care must be taken to remove all rusting ironwork from the interior of the walls.

REINFORCEMENT

Bands of reinforcement (see Fig. II) must be formed in the thickness of the walls, of a sufficient strength to restrain all outward movement.

These will be necessary at different levels, but the most important should be at the springing level of the main arches beneath the dome.

To obtain continuity of the reinforcement, tie-bars of stainless steel will have to be placed across these arches; they need not be conspicuous, and are a usual feature of medieval domed and vaulted buildings, especially in countries subject to earthquake shocks.

This upper main band should be continued along the walls of both Transepts, and will also encircle the eastern arm and apse, while a smaller band through the walls of the Tower should be attached by reinforcements hidden in the thickness of the roof.

A lower series of reinforcements must also be placed in the walls of the old Baptistery and the Chapel of St. James, which leans dangerously towards the street. This band should be carried through into the vaults between the Rotunda and South Transept, and anchored to the main piers.

A series of tie-bars across the arches of the upper Rotunda gallery, connected to a band of reinforcement in the outer wall may also be required to stabilize this wall and the inner colonnade.

PART III

RECOMMENDED ALTERATIONS, DESIRABLE ON ARCHAEOLOGICAL OR UTILITARIAN GROUNDS

QUITE apart from the problem of the structural security of the fabric is that of archaeological interest and also that of the general usefulness of the structure. These latter aspects demand special consideration in connexion with structural repair for at least two reasons. In certain cases, the scheme of repair may differ, to a greater or less degree, in accordance with the view taken of certain portions of the building, which may have had no part in the original structure. In the second place, if certain alterations are desired, it is both easier and more economic to effect them during the main work.

The possible alterations to be discussed fall under the following heads:

(i) Those not affecting the structure or the scheme of repair.

(ii) Those affecting the present arrangements of the structure but not the scheme of repair.

(iii) Those affecting the scheme of repair and involving rebuilding of lost work.

The alterations comprised in category (i) can in all cases be undertaken as subsidiary parts of the main work of repair. They affect only the general appearance and condition of the present structure, without necessitating alteration.

The second, and largest, quota of alterations are those which, while not affecting the general repairs, would alter the present division and use of the Church by removing wooden partitions, opening old doors, and in general returning the Church to its original condition. In completing such a plan of restoration, the third type of alteration would be undertaken: that is to say, the work of repair would be so modified as to discard post-twelfth-century portions of the fabric, or to restore and rebuild

such vestiges of the old design as could be brought to light. A further step would be the rebuilding of vanished parts of the Church in a form as close to the original as possible. In one case this has a special bearing on the repair work, as the upper walls of the apse in any case require reconstruction, and it seems doubtful whether the present inharmonious design should be retained.

In considering all these archaeological alterations, the primary aim has been to reveal all that exists of the Church in its unaltered state. The supplying of missing features, whether small or large, must be determined by the artistic fitness of the case, and in the light of the results to be achieved.

ALTERATIONS IN CLASS i NOT AFFECTING THE STRUCTURE OR THE SCHEME OF REPAIR

(1) An alteration which would affect the whole Church, though without changing the present arrangement, would be the stripping off of all plasterwork, thus revealing the original stone faces, which would then be carefully washed. As very large portions of the plasterwork would in any case be removed during the work of repair, this would involve little extra labour, and would greatly improve the appearance of the interior. Special care would have to be taken to ensure that any traces of original mosaic or colouring would be preserved (see Figs. 73, 74, 75).

(2) All windows which are now blocked should be reopened, as the whole building suffers considerably from lack of light and air. Windows which have been partly blocked as a result of material being added to the original roof levels, would be fully cleared during the removal of these accretions for the main work of repair. A number of windows in the ambulatory and chapels at the East end of the Church are now enclosed on the exterior by various small rooms in the Coptic and Abyssinian Monasteries. These could be opened, and windows inserted, or existing windows enlarged, in the opposite walls of these rooms.

The following is a list of windows completely blocked:

1. High vault North Transept West wall (1).
2. High vault East arm South wall (1) (see Fig. 76).
3. Ambulatory North-east apsidal chapel (2) (see Fig. 77).
4. Ambulatory centre apsidal chapel (3) (see Fig. 78).
5. Above stair to St. Helena's Chapel (1).
6. Ambulatory South-east apsidal chapel (2).

Those partially blocked (not by raising of roofs) are:

1. High vault North Transept North wall (2) (see Fig. 79).
2. High vault East arm North wall (1).
3. Eastern arm North wall—to Latin chamber (shuttered) (2).

(3) The pavements of the whole Church should be taken up and reset on a concrete bed. Great care should be taken to preserve all ancient pavements or fragments.

Pavements which require special treatment are:

1. Chapel of the Apparition (see Fig. I, 14). The new marble slabs should be taken up, and the original mosaic reinserted. (The original is at present in the Latin gallery of the Rotunda.) (See Fig. 80.)
2. Chapel of the Franks (see Fig. I, 44) (Chapel of Our Lady of the Seven Sorrows). This original pavement requires very careful resetting, and the insertion of a few small fragments (see Fig. 81).
3. Latin Calvary Chapel (see Fig. I, 43). This pavement contains much original work, which should be reset.

(4) The pavement of the Parvis (see Fig. I) should be taken up and reset on a concrete bed, with proper falls for rain-water drainage. Much of the old stone could be re-used, but hollows caused by slabs in a highly fractured state should be avoided.

The work should be done with special regard to possible remains of archaeological interest beneath (see Fig. 82).

(5) The stair from the Chapel of St. Helena to the Grotto of the Invention should have its present iron gratings removed; the original steps can then be reset, with insertions of new stone where necessary (see Figs. 83, I, 28, 29).

ALTERATIONS IN CLASS ii AFFECTING THE PRESENT ARRANGEMENTS OF THE STRUCTURE, BUT NOT THE SCHEME OF REPAIR

(1) The reopening of the eastern main doorway of the Church (see Fig. 84) and the removal of the modern work behind it enclosing the present double stair to Calvary. This would also remove a small portion of the western end of the Greek room under the southern stair, and of the Chapel of Adam. The place of the removed lintel-carvings should be filled either with good casts, or with well-carved copies (see Frontispiece to Report).

(2) The return of the so-called Chapel of the Franks to its original purpose, as a porch to Calvary (see Fig. 85). This would entail the removal of its altar, the reopening of the original doorway to Calvary (now a grated window) (see Fig. 86) and the removal of both the modern masonry, door and stained glass in the West wall, and of the stained-glass windows in the South wall. It would then form an open arcaded porch as in its original state.

(3) The reduction in height of the present high walls of the Katholikon, between the main piers, to their original proportions, and the removal of the modern screen and railing at the West end of the Katholikon (see Figs. 87, 88).

(4) The removal of the modern walls and doorways in the bay to the east of the central space, which fill the North and South arcades (see Fig. I, 5).

(5) Removal of modern vaults and partitions over the South aisle, connecting with the Calvary Chapels (see Fig. 89), and the reopening of the original stairs to Calvary from this aisle.

(6) Removal of modern work from the Chapel of Adam beneath Calvary (see Figs. 90, I, 11).

(7) Removal of all modern partitions, stairs, &c., in outer aisle of Rotunda, and reopening of it as a complete passage surrounding the Sepulchre (see Figs. 91, I, 15, 23).

(8) Removal of modern work over aisle leading to the

Rotunda and Armenian Sacristy from South Transept (see Fig. 92).

(9) Removal of partitions and cupboards preventing free lighting of the South Transept, through the Armenian gallery (see Figs. 93, II, 4).

(10) Removal of arched screens built in 1810 from the three chapels surrounding the ambulatory (see Fig. I, 8, 9, 10).

(11) The reopening of the old door in the north-east of the ambulatory, as an access to the Coptic Convent, the Ninth Station, and the lane beyond (see Figs. 94, I, 30).

(12) Removal of pillars and pediment built in 1810 from archway leading to the Chapel of the Bonds (see Figs. 95, I, 17).

(13) Removal of the present partitions and wooden galleries from the western bays of the Chapel of St. Helena (see Figs. 96, 97, I, 28).

(14) Reopening of original St. Mary's Door in Christian Street, as an entrance to the Church, communicating with the passage to the North apse of the Rotunda. This would necessitate certain alterations in the piers supporting the vault over Christian Street (see Figs. 98, 99, I, 22).

(15) Alteration of the present Latin Refectory to allow of opening of Byzantine arcade now enclosed in its western wall (see Figs. 100, I, 20).

(16) Reopening of blocked door to spiral staircase of Tower in West wall of Chapel of the Forty Martyrs, and small windows above, to stair (see Figs. 101, I, 31).

(17) Reconditioning of arcaded wall and recesses in the Chapel of St. James (at the South-west angle of the Parvis) (see Figs. 102, I, 33–V).

(18) Removal of modern accretion from beneath Byzantine octagonal cupola to east of Chapel of Melchizedek, and opening of old window in its South-east wall (see Figs. 103, 104, II, 12).

(19) Removal of modern floors and partitions inside old arch of upper ambulatory, leading to the Greek Terrace, and reopening of arch as a doorway (see Fig. 105).

(20) Return from the Church of St. Anne of niche removed

in 1870 and its restoration to its original position on the roof of the Rotunda gallery, as a window opening through the upper blind arcade of the Rotunda drum (see Fig. 106).

(21) Removal from the South face of the Tower of the modern room added to the floor above the vault of the Chapel of the Forty Martyrs (see Fig. 107).

ALTERATIONS IN CLASS iii AFFECTING THE SCHEME OF REPAIR AND INVOLVING THE REBUILDING OF LOST WORK

(1) During the reconstruction of the apse, made necessary by its decay, it should be redesigned as far as possible according to its original form, and, in any case, to harmonize with the general design of the building (see Figs. 108, 110, I, 6).

(2) It will probably be found that the original twin columns of the lower apse arcade exist inside the present square piers. If so, they should be revealed, and reconstructed if necessary to bear the load. In any case, twin columns following the original design should be substituted for the massive piers (see Figs. 109, 110).

(3) Twin columns of twelfth-century type as originally used should be inserted in the place of the present double pier inside the main entrance (see Figs. 111, 112), and a similar respond on the South wall.

(4) Should remains be found during the work of repair in the Rotunda piers, of the original columns, they should be reconstructed, and the arcade and galleries returned as nearly as possible to their original Byzantine form (see Fig. 113).

In addition to the alterations suggested above, certain others would be required to restore to the fabric its form as at the end of the twelfth century. They would consist of rebuilding lost portions of the Church in accordance with:

(*a*) Vestiges remaining *in situ*.

(*b*) Fragments removed to other sites.

(*c*) Old drawings showing the earlier state of the Church.

The principal cases of this would be:

(1) The rebuilding of the arcade across the front of the

Parvis, from the present remains: the western half pier and portion of one arch, with above it a fragment of the original crowning mouldings of the arcade, and the bases still *in situ* (see Figs. 114, I, 41).

(2) The rebuilding of the dome over the old Baptistery south of the Tower, and the subsequent removal of the lower vault which partially covers the space at present; also the opening of the blocked window in the eastern face (see Figs. 115, 116, I, 32–II, 19).

(3) The rebuilding of the upper stories and roof of the Tower. This would be in accordance with the bases of an upper arcade still *in situ*, by comparison with the marble columns now re-used in the Chapel of Constantine on the roof nearby, and with many old engravings and drawings, taken while the Tower remained entire (see Fig. 117).

(4) The removal of the present dome over the Rotunda and its replacement by a cone following the original design, which was adhered to in many rebuildings up to the fire of 1808 (see Figs. 113, 118).

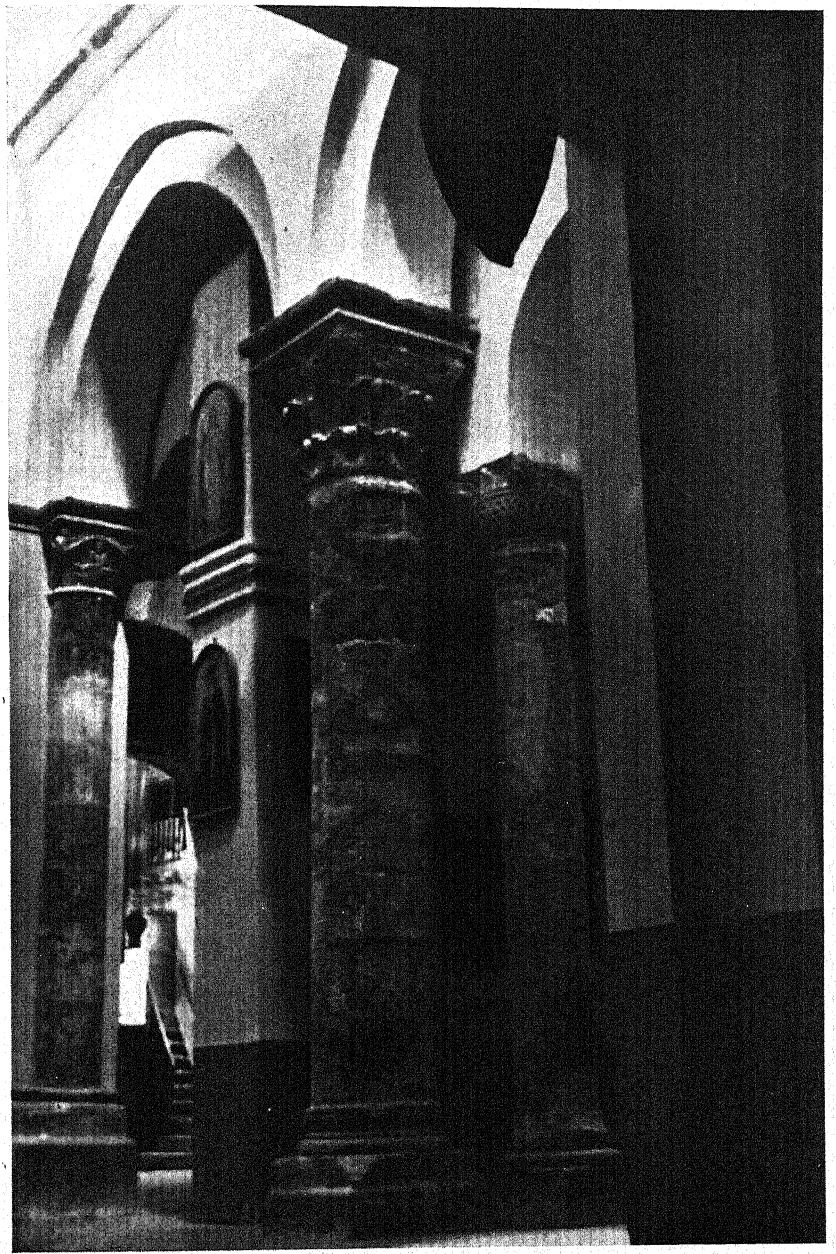


FIG. 73. PIERS OF NORTH TRANSEPT, SHOWING MASONRY AND PLASTERED FACES

FIG. 74. GREAT ARCH OF ROTUNDA, SHOWING PLASTERING OF 1810 CONCEALING CARVED WORK

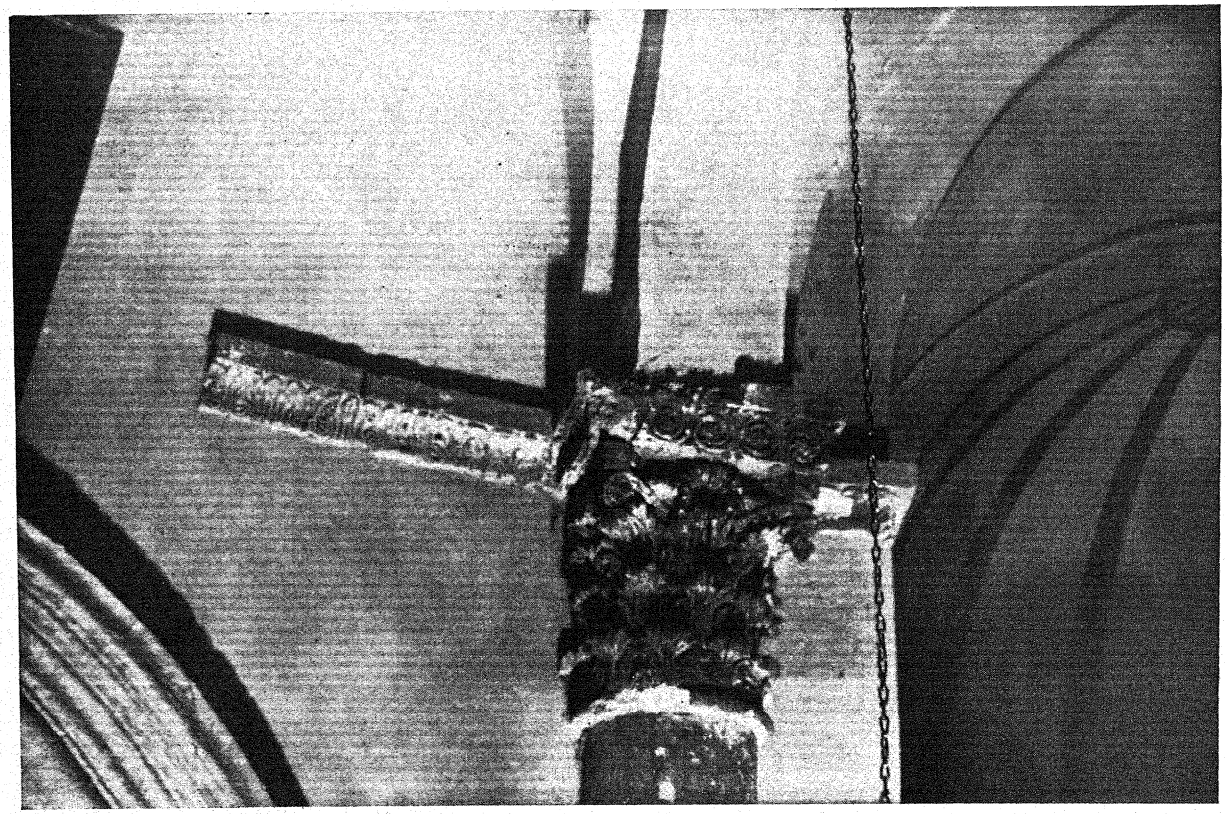


FIG. 75. CAPITAL IN AMBULATORY

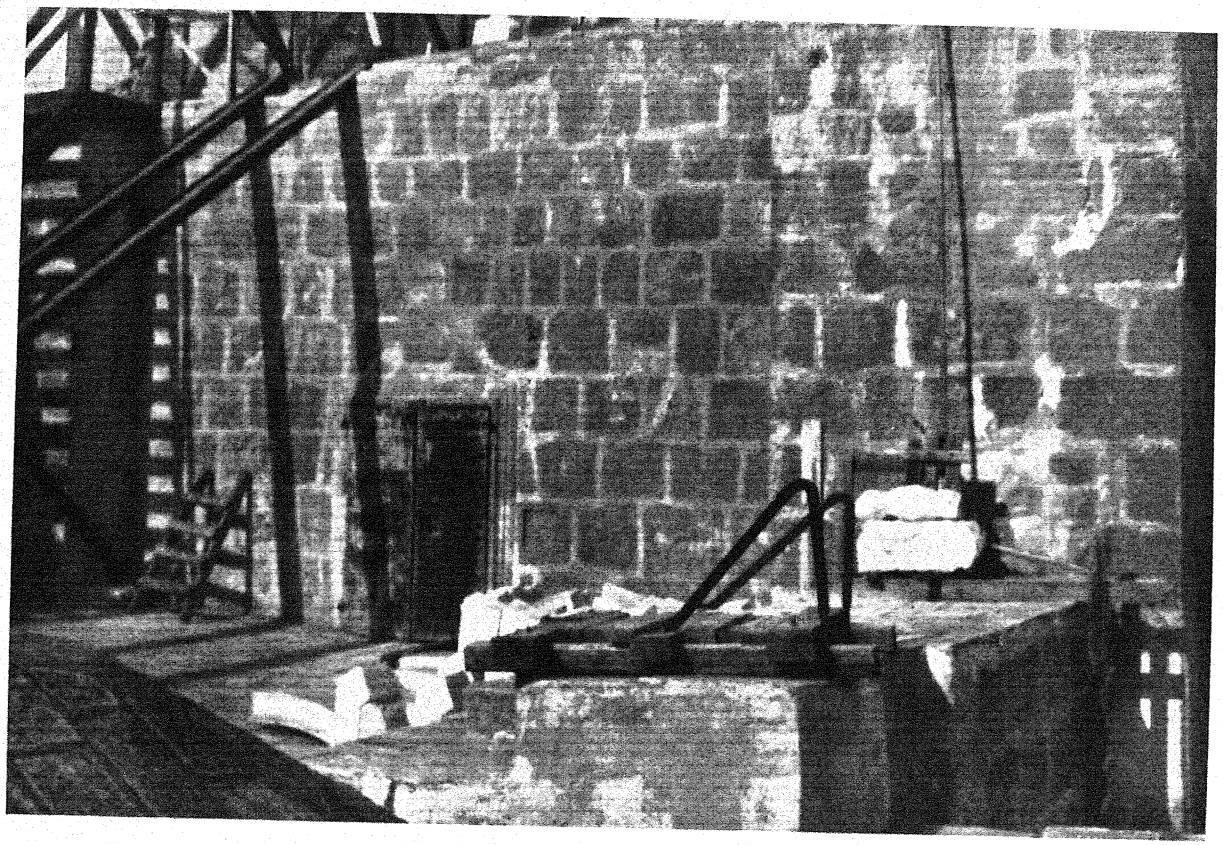


FIG. 76. WINDOW BLOCKED BY IRON DOORS

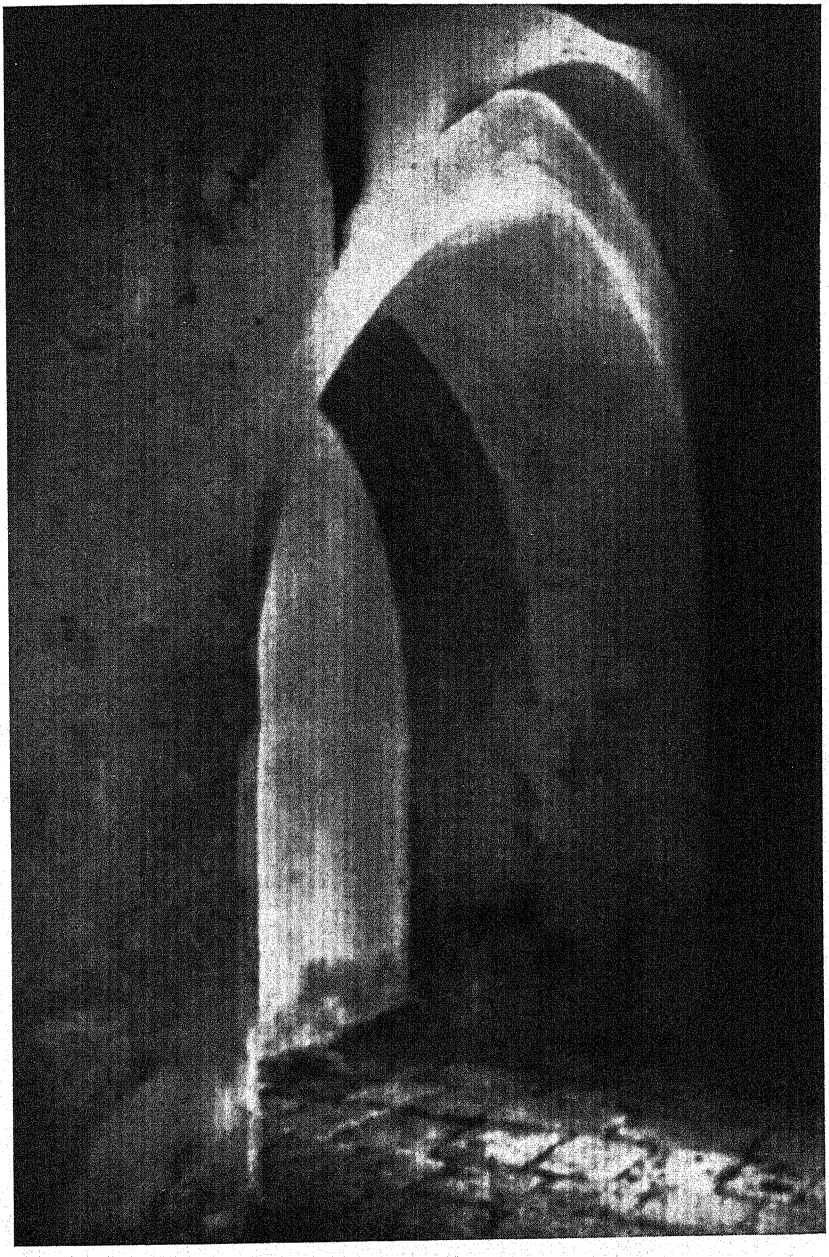


FIG. 77. BLOCKED WINDOW OF AMBULATORY

FIG. 78. BLOCKED WINDOW OF CENTRAL APSE CHAPEL

FIG. 79. PARTIALLY BLOCKED WINDOWS OF NORTH TRANSEPT

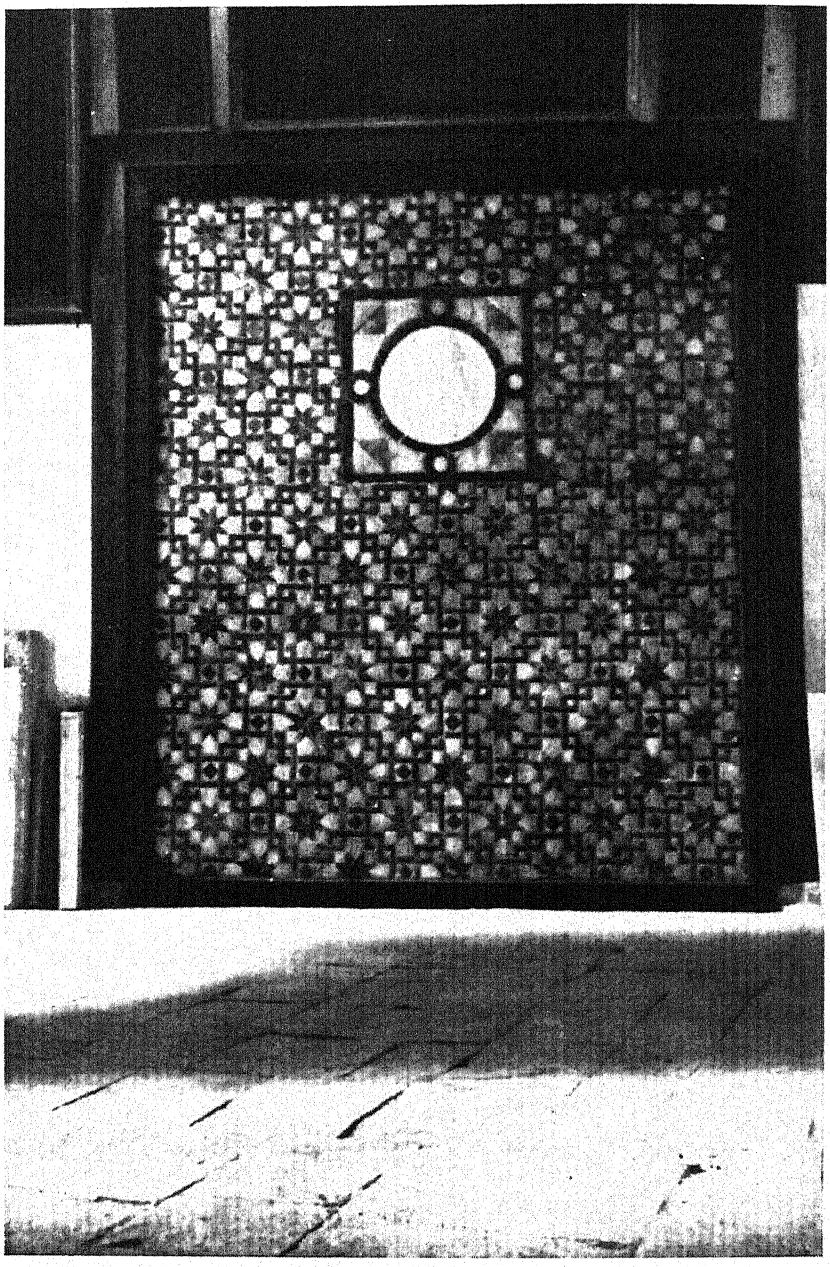


FIG. 80. PAVEMENT REMOVED FROM CHAPEL OF APPARITION

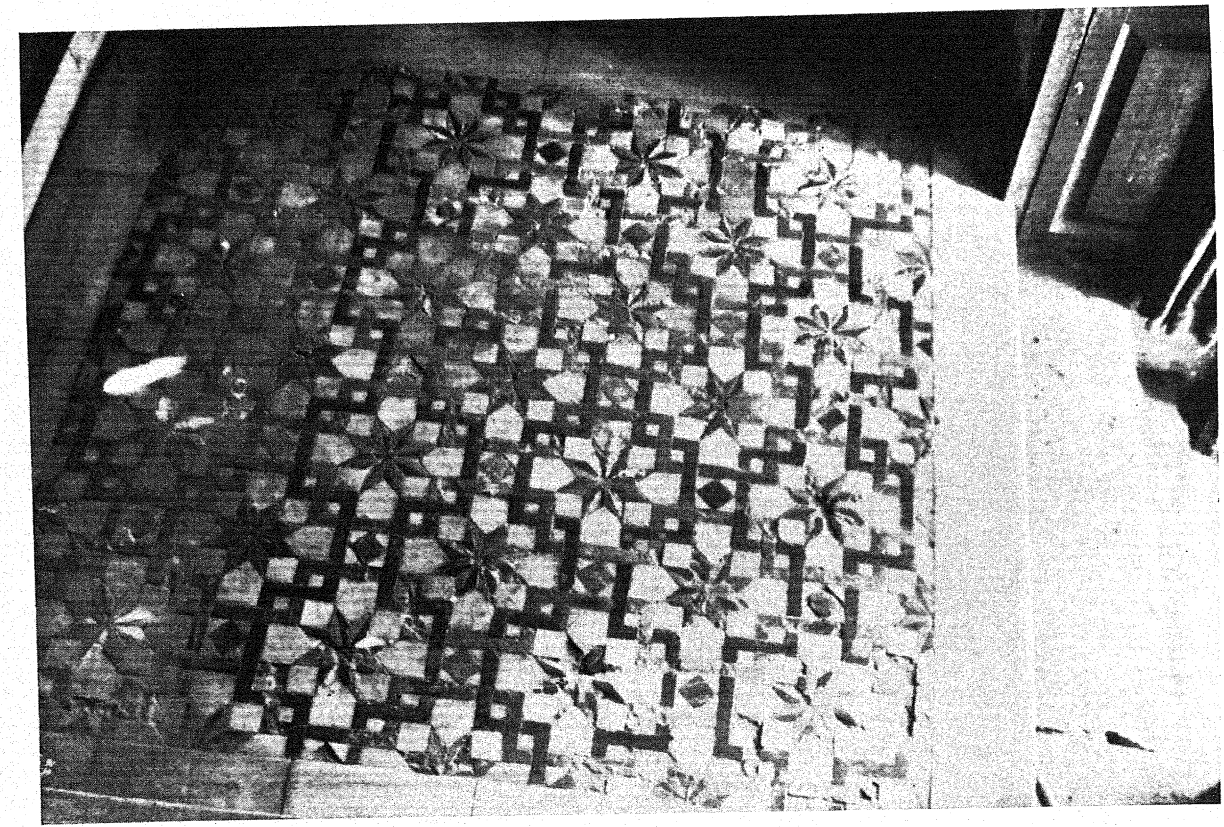


FIG. 81. PAVEMENT IN CHAPEL OF THE FRANKS

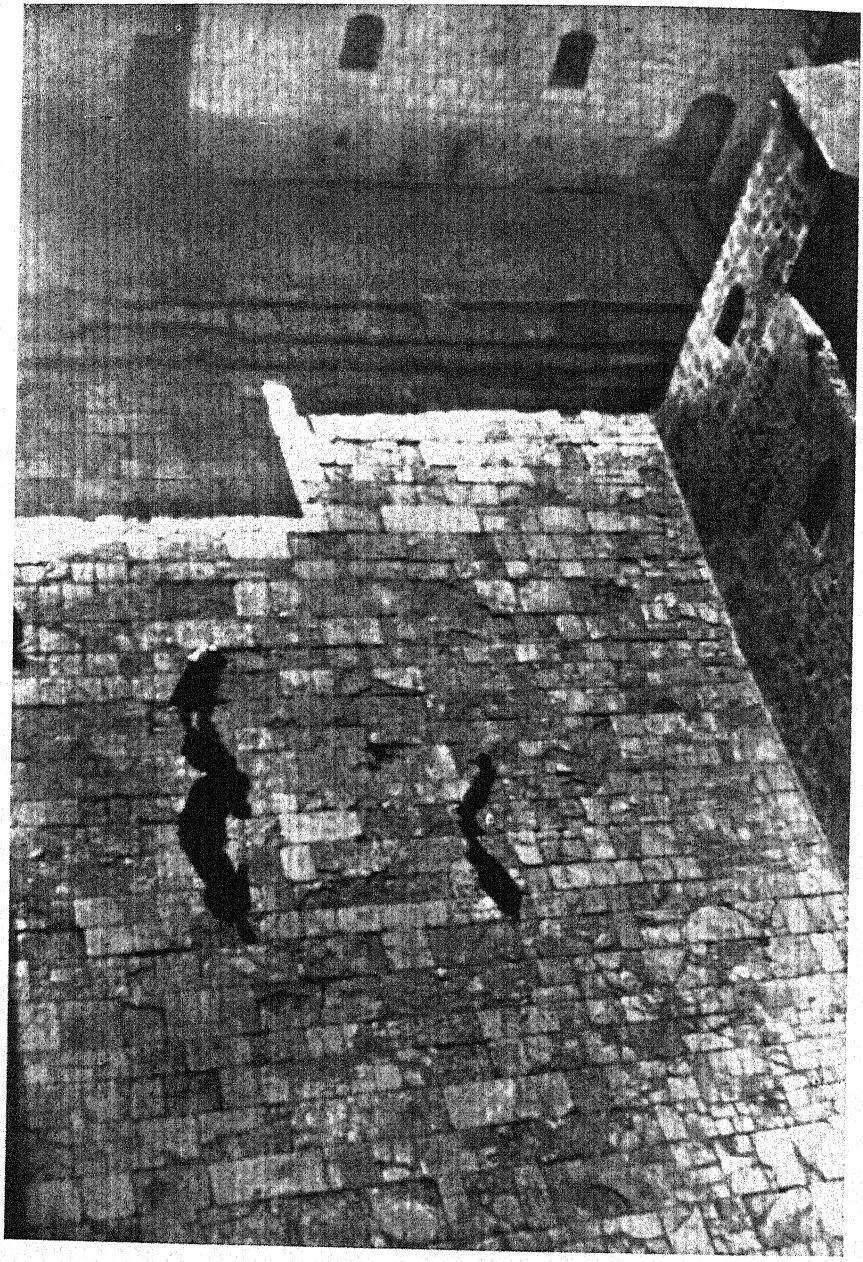


FIG. 82. PAVEMENT OF PARVIS FROM ABOVE

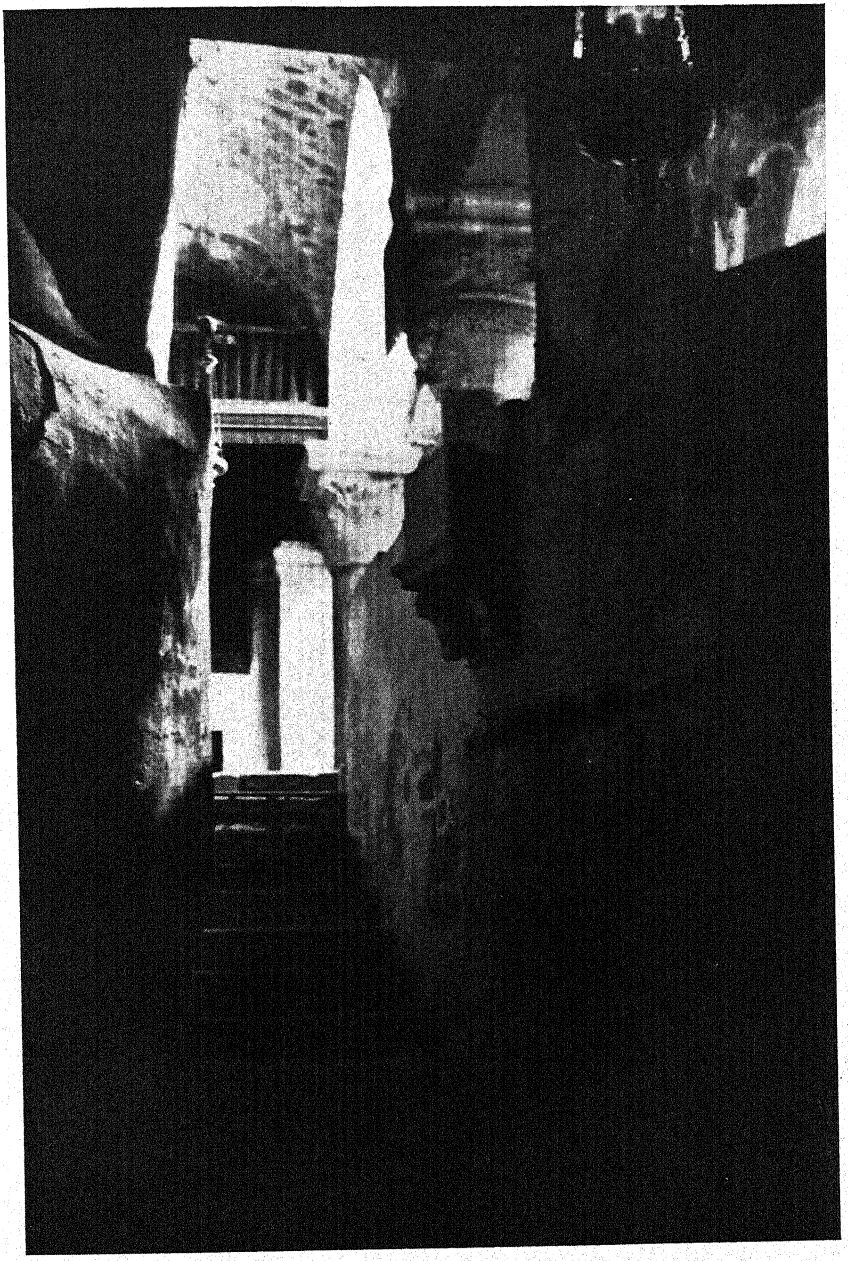


FIG. 83. STAIRS FROM GROTTO OF THE INVENTION

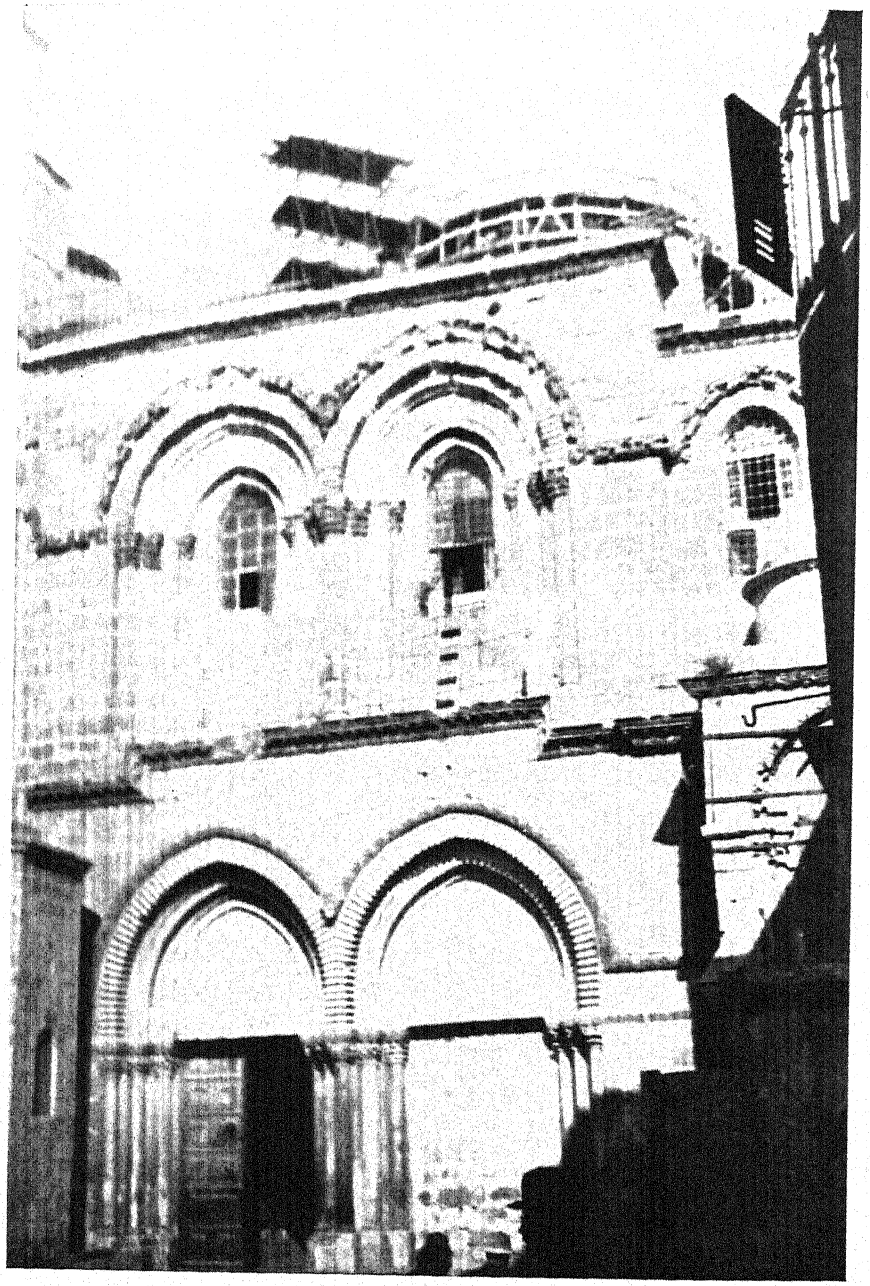


FIG. 84. MAIN FRONT

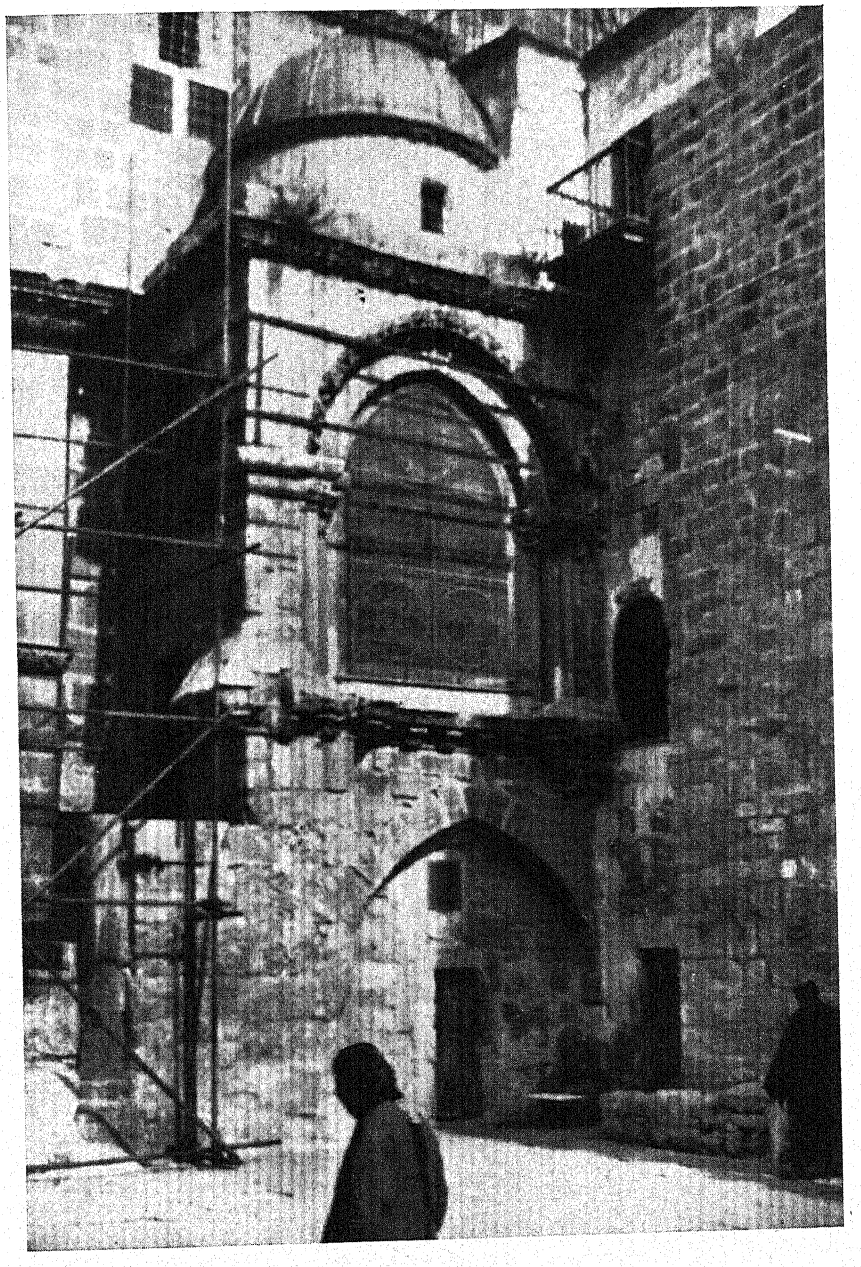


FIG. 85. CHAPEL OF THE FRANKS

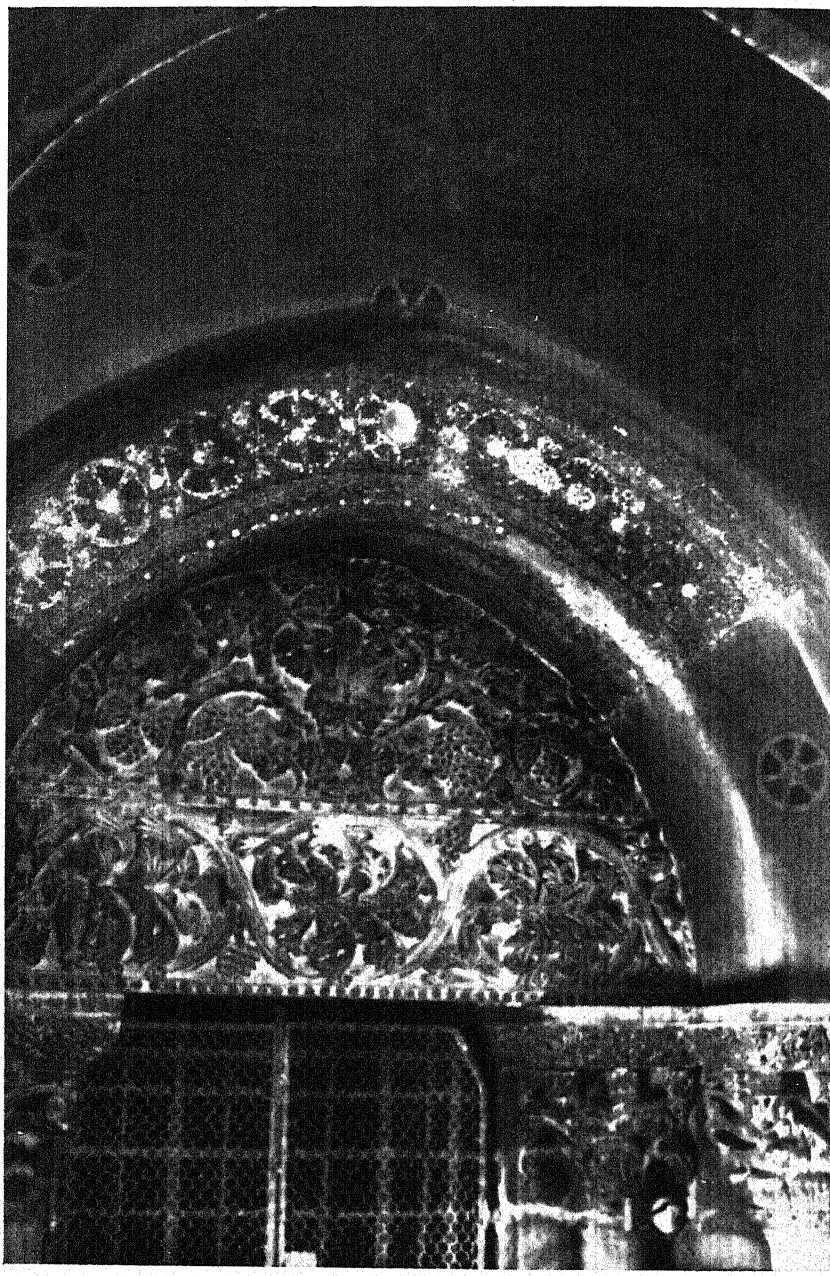


FIG. 86. BLOCKED DOOR TO CALVARY

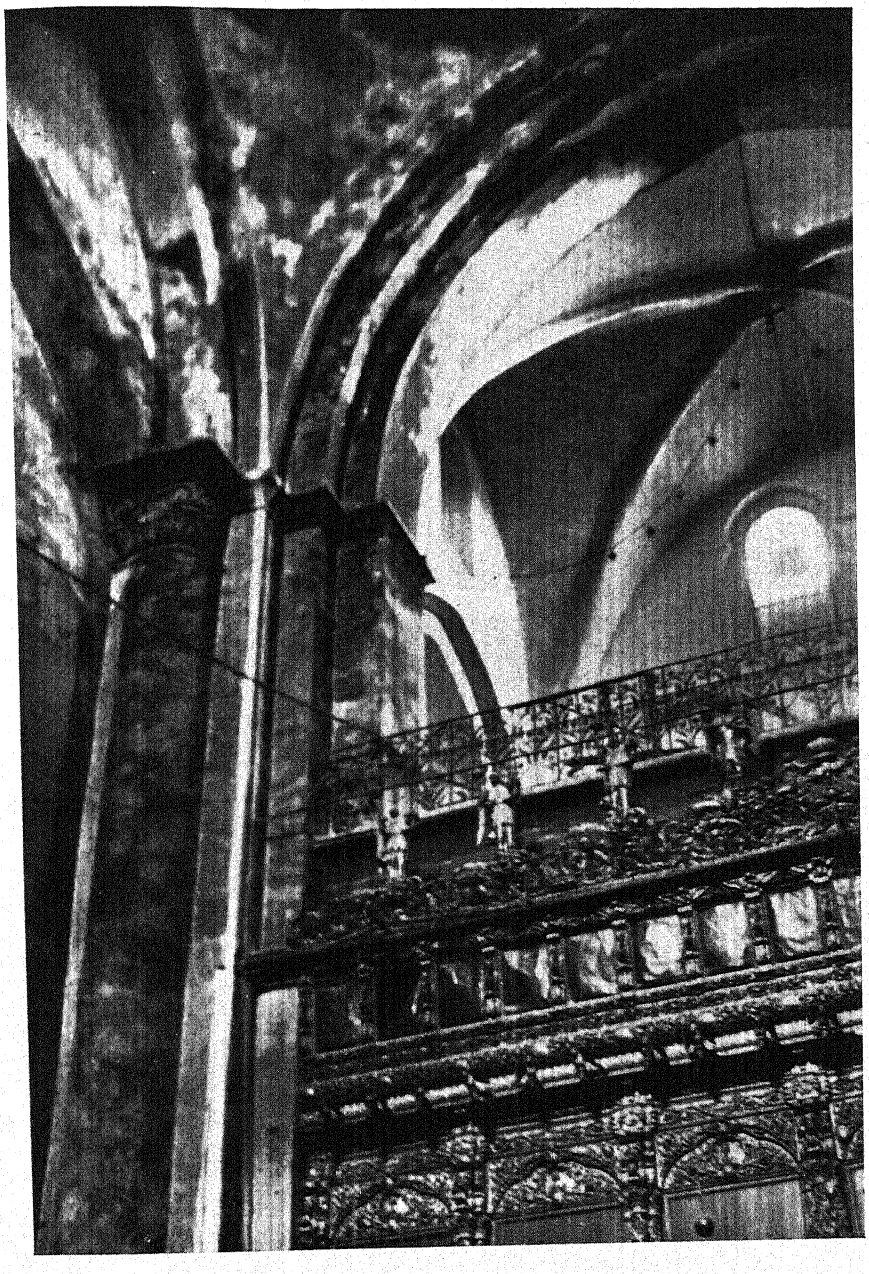


FIG. 87. NORTH ARCH OF KATHOLIKON

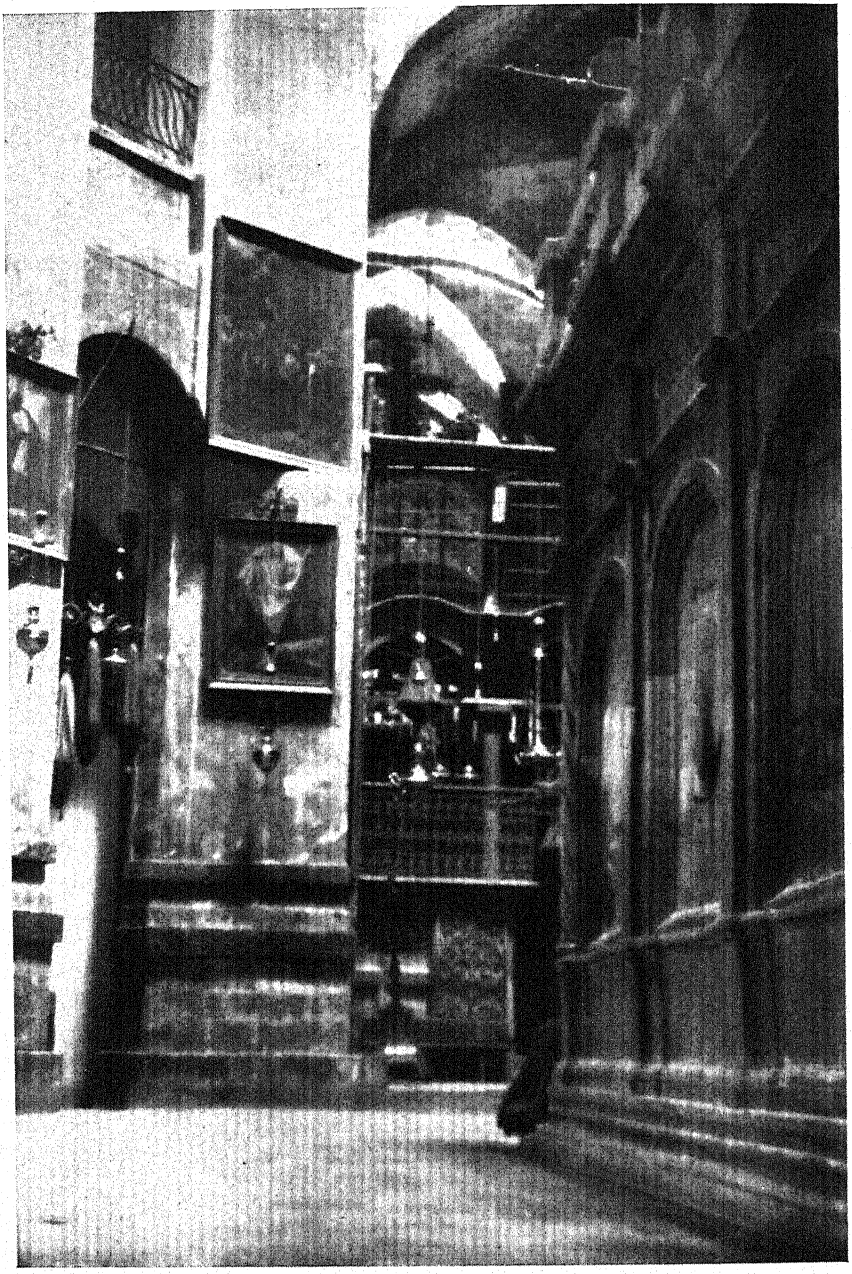


FIG. 88. ROTUNDA LOOKING EAST

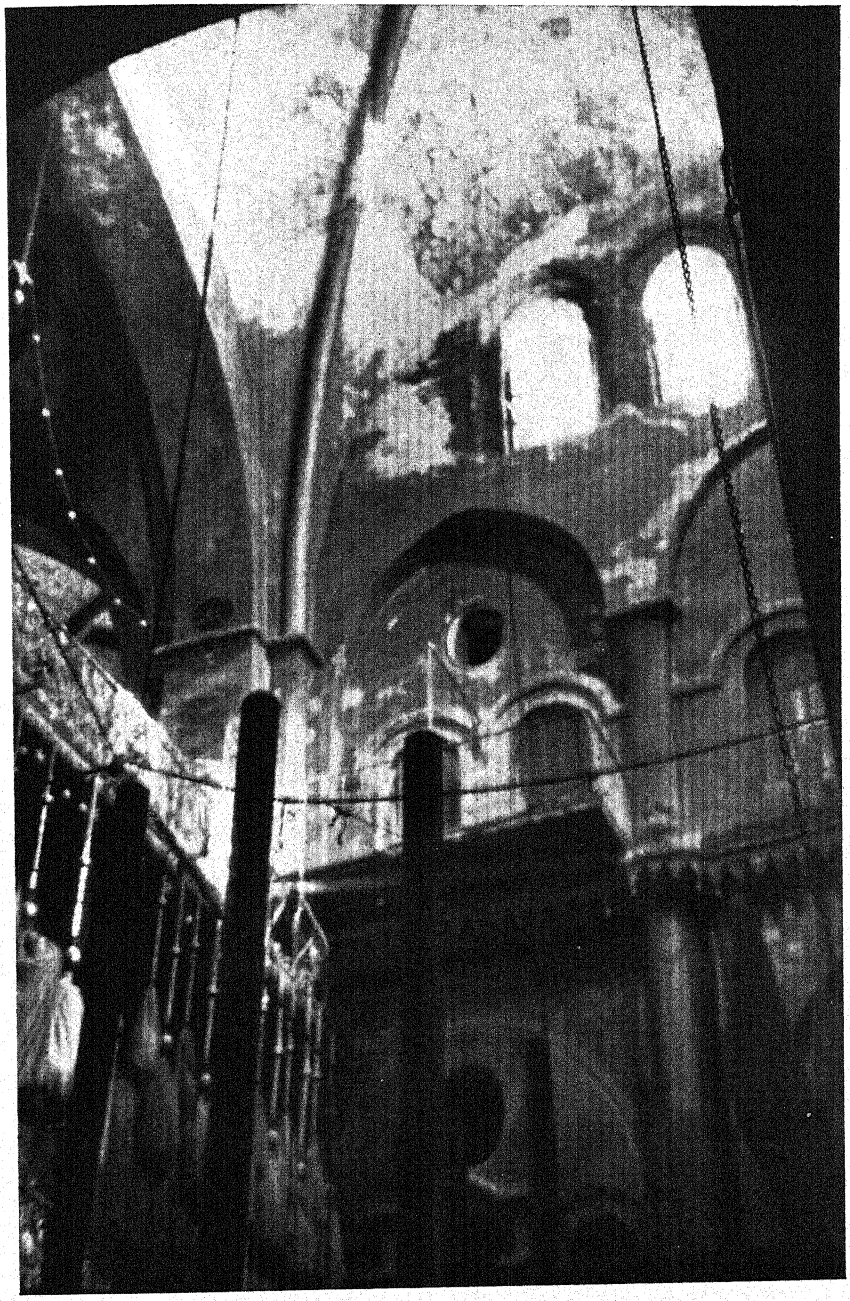


FIG. 89. SOUTH TRANSEPT EAST WALL

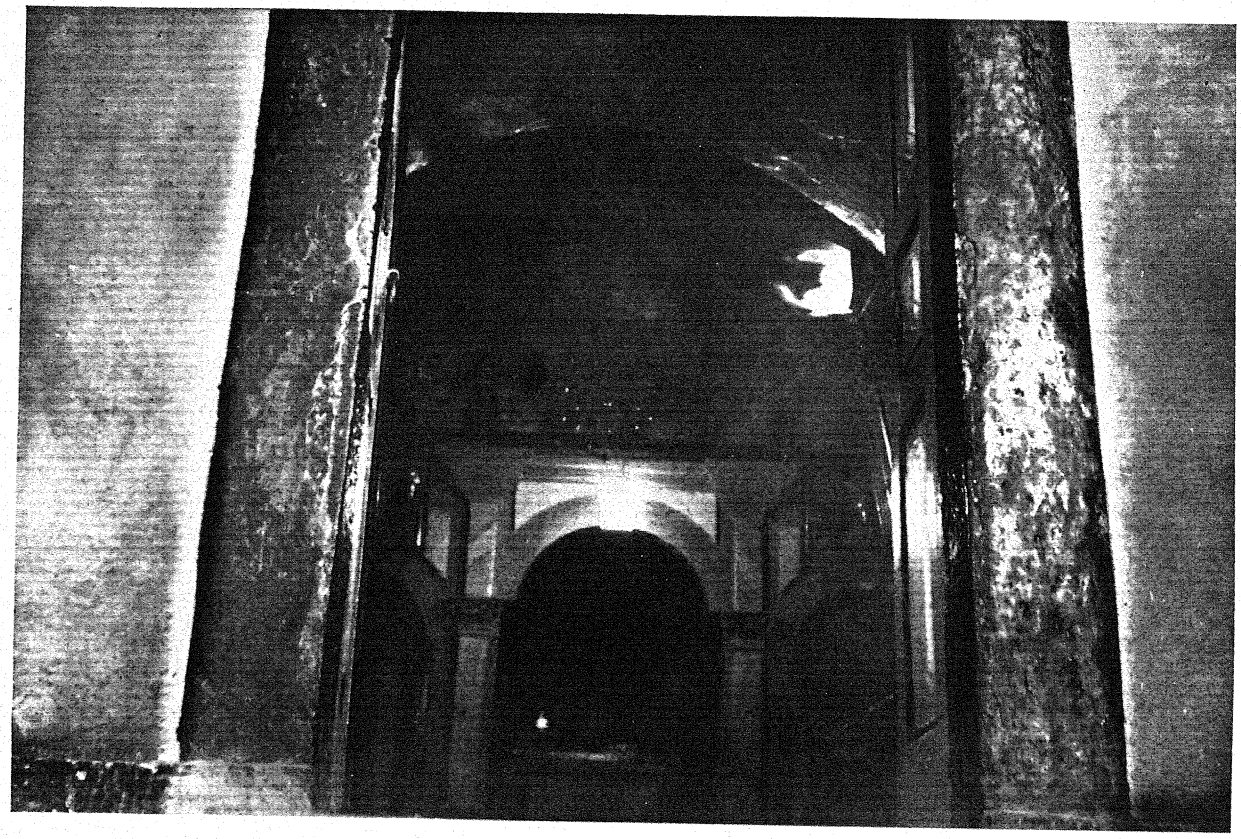


FIG. 90. CHAPEL OF ADAM

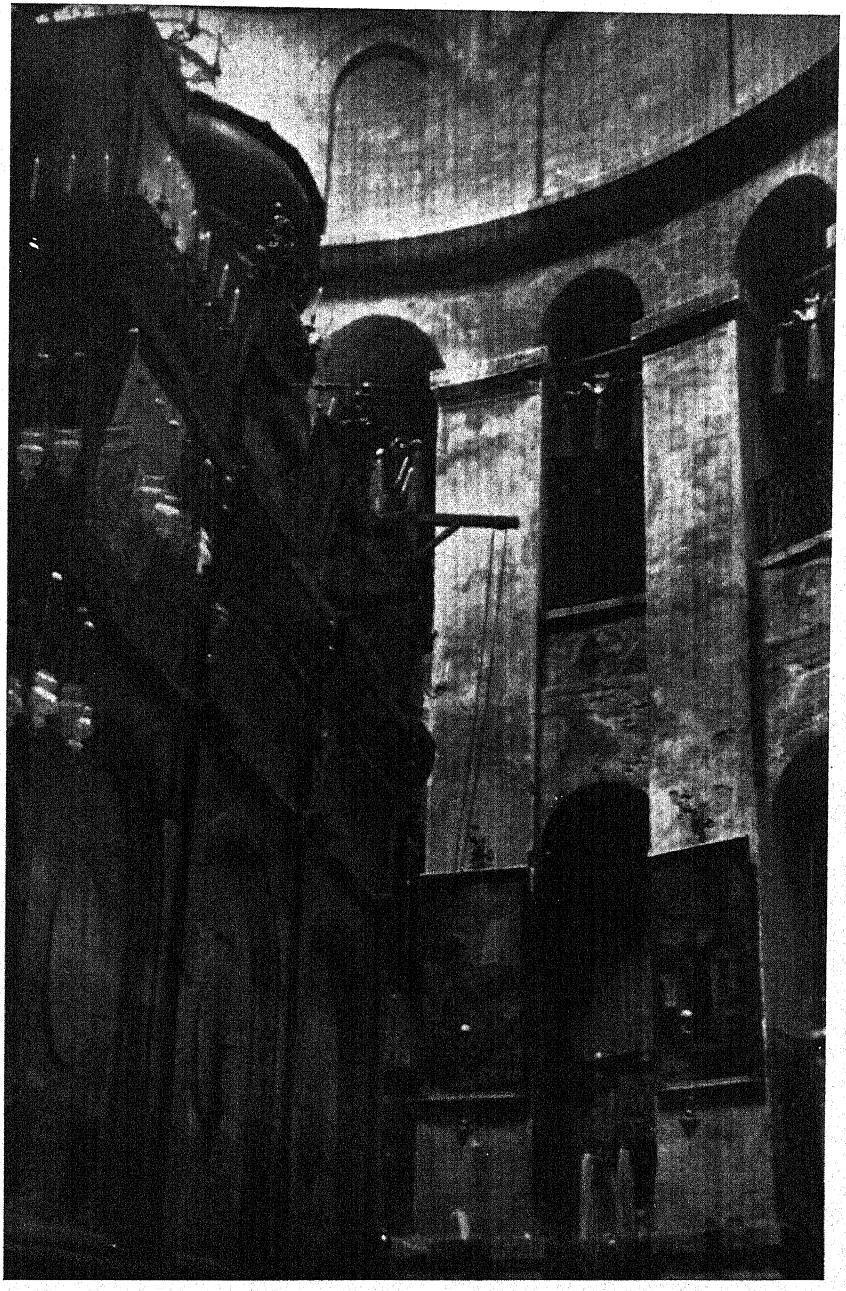


FIG. 91. ROTUNDA PIERS

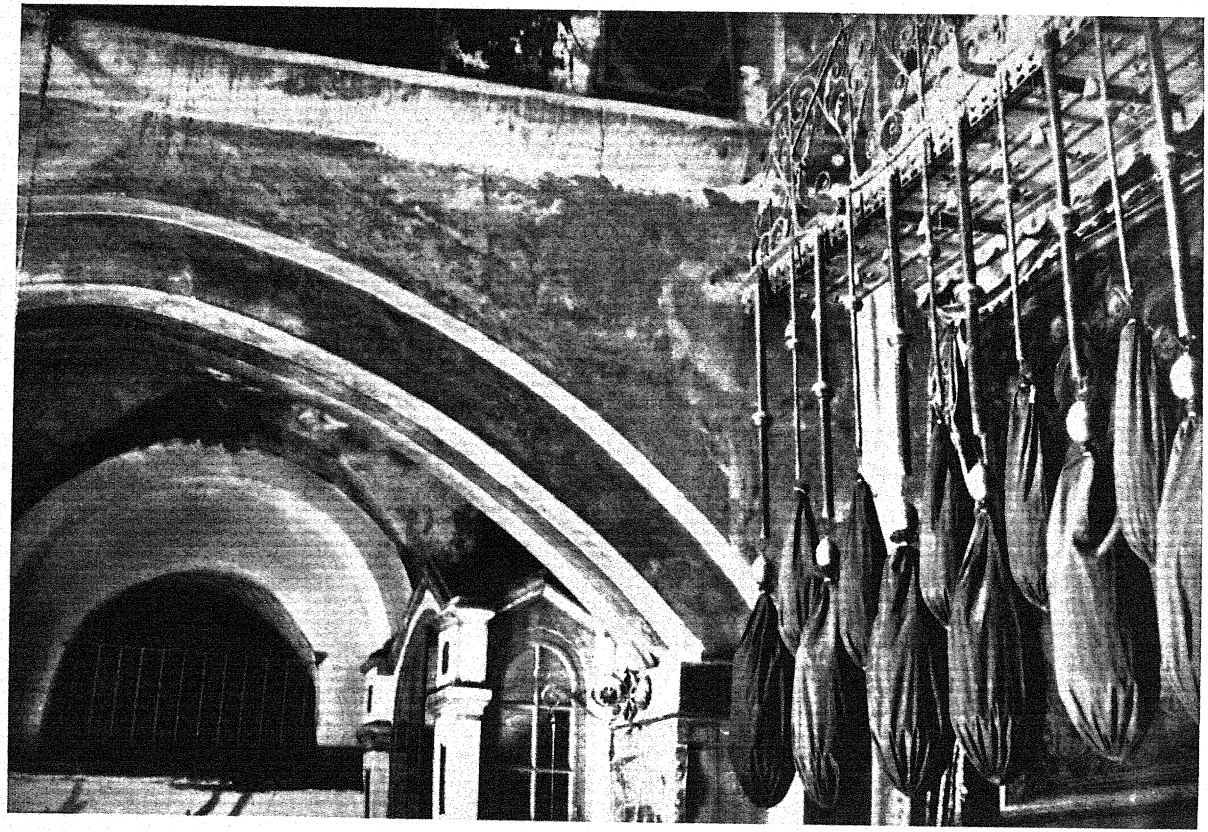


FIG. 92. SOUTH TRANSEPT, WEST ARCH

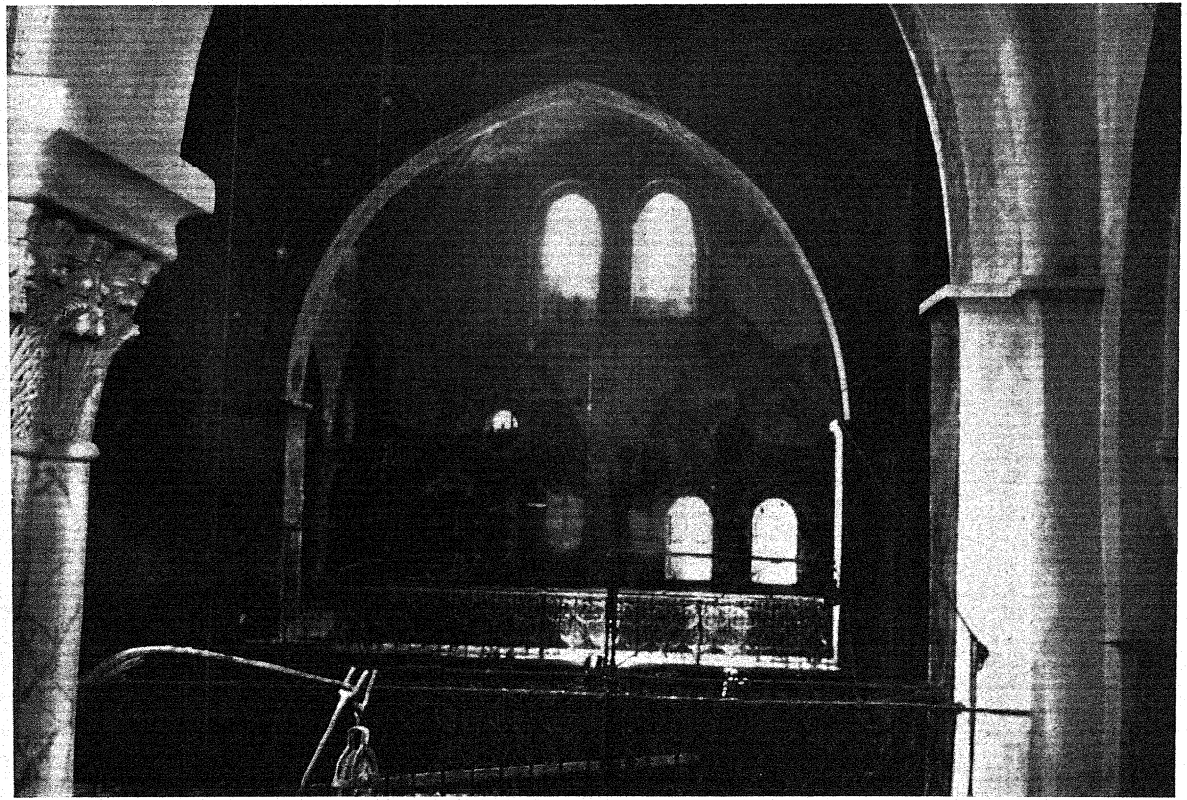


FIG. 93. SOUTH TRANSEPT FROM NORTH TRANSEPT

FIG. 94. AMBULATORY

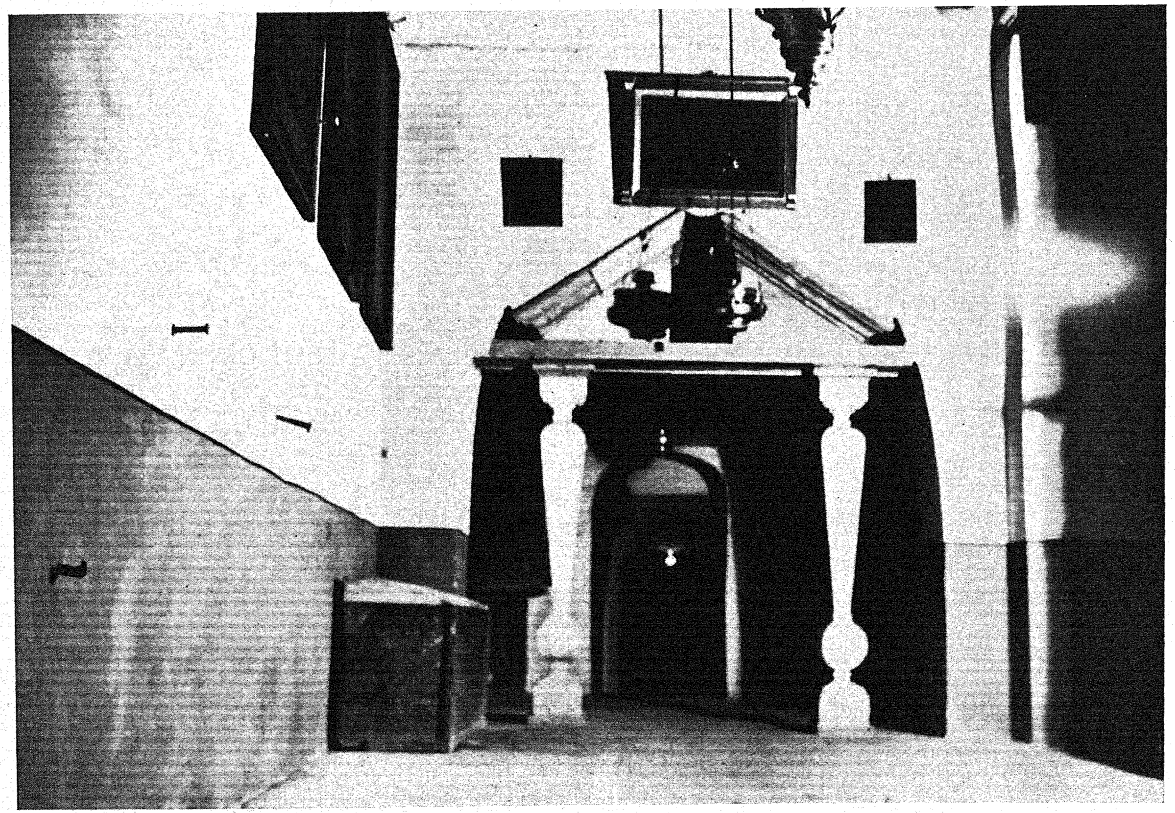


FIG. 95. PORTAL OF 1810 TO CHAPEL OF BONDS

FIG. 96 ST. HELENA'S CHAPEL. NORTH-WEST BAY

FIG. 97. STAIRS FROM ST. HELENA'S CHAPEL

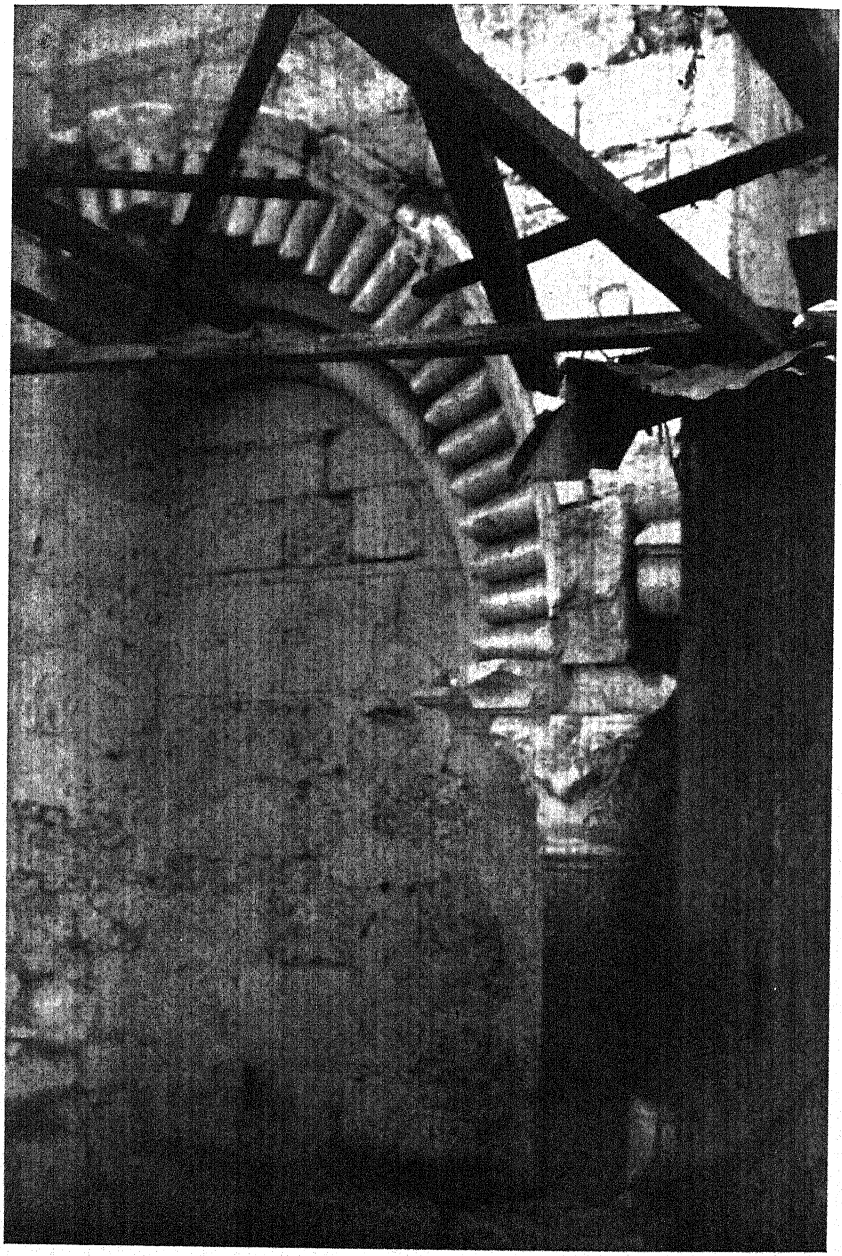


FIG. 98. ST. MARY'S GATE, CHRISTIAN STREET

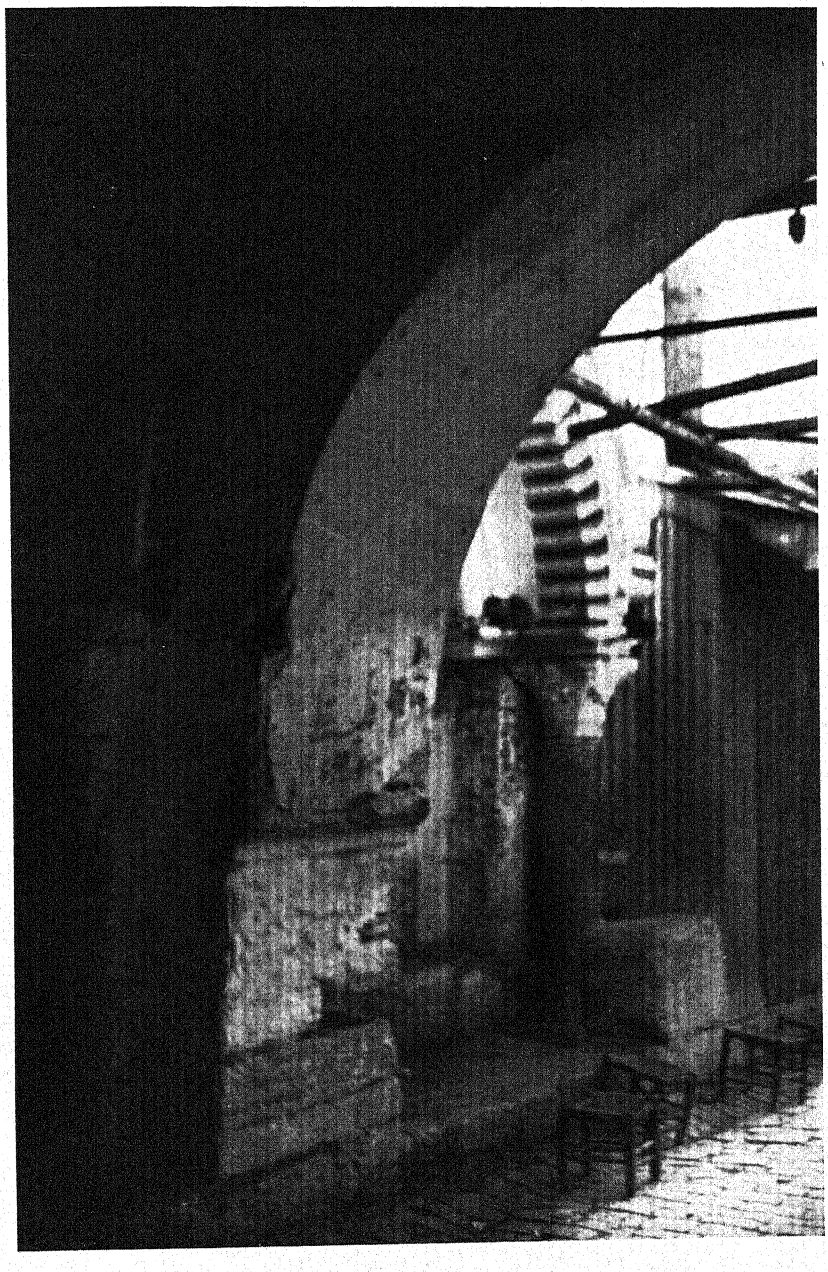


FIG. 99. ST. MARY'S GATE

FIG. 100. BYZANTINE ARCADE IN LATIN REFECTORY

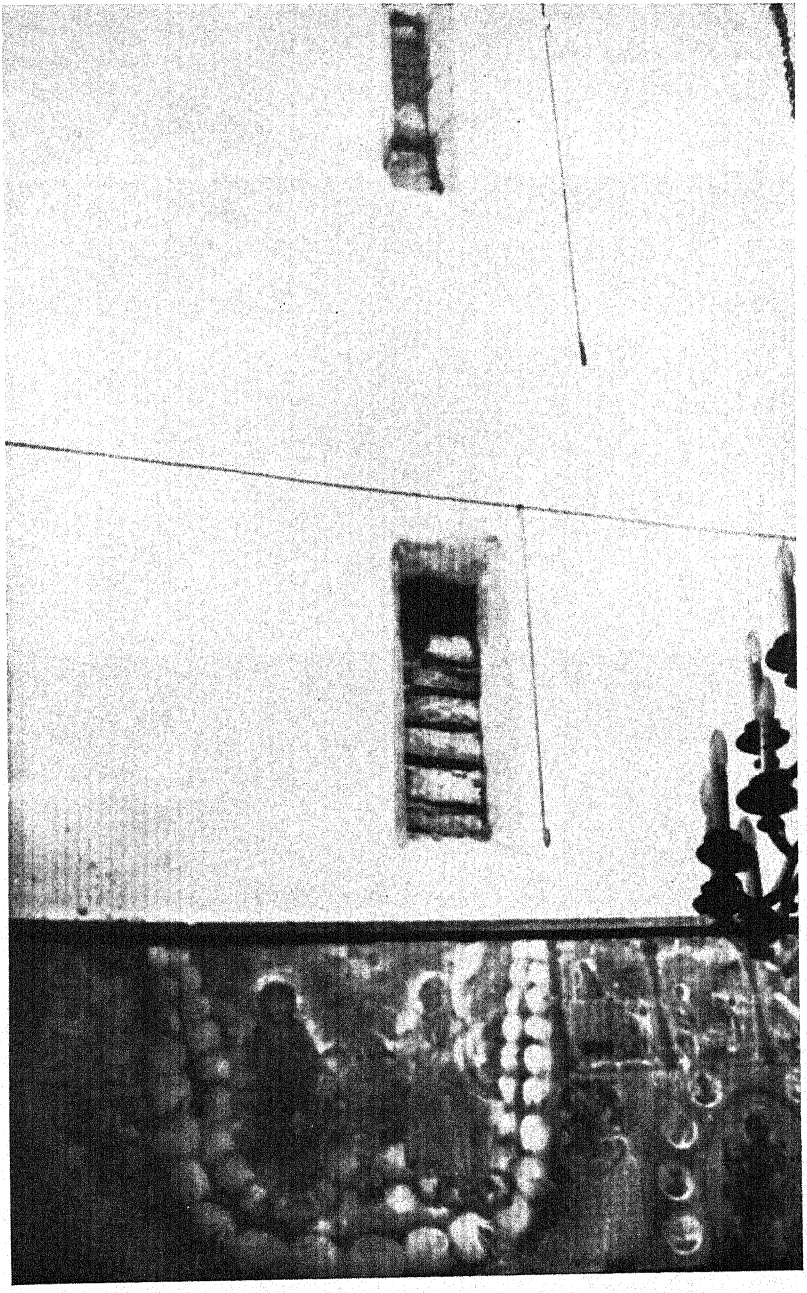


FIG. 101. WINDOWS TO STAIR IN TOWER

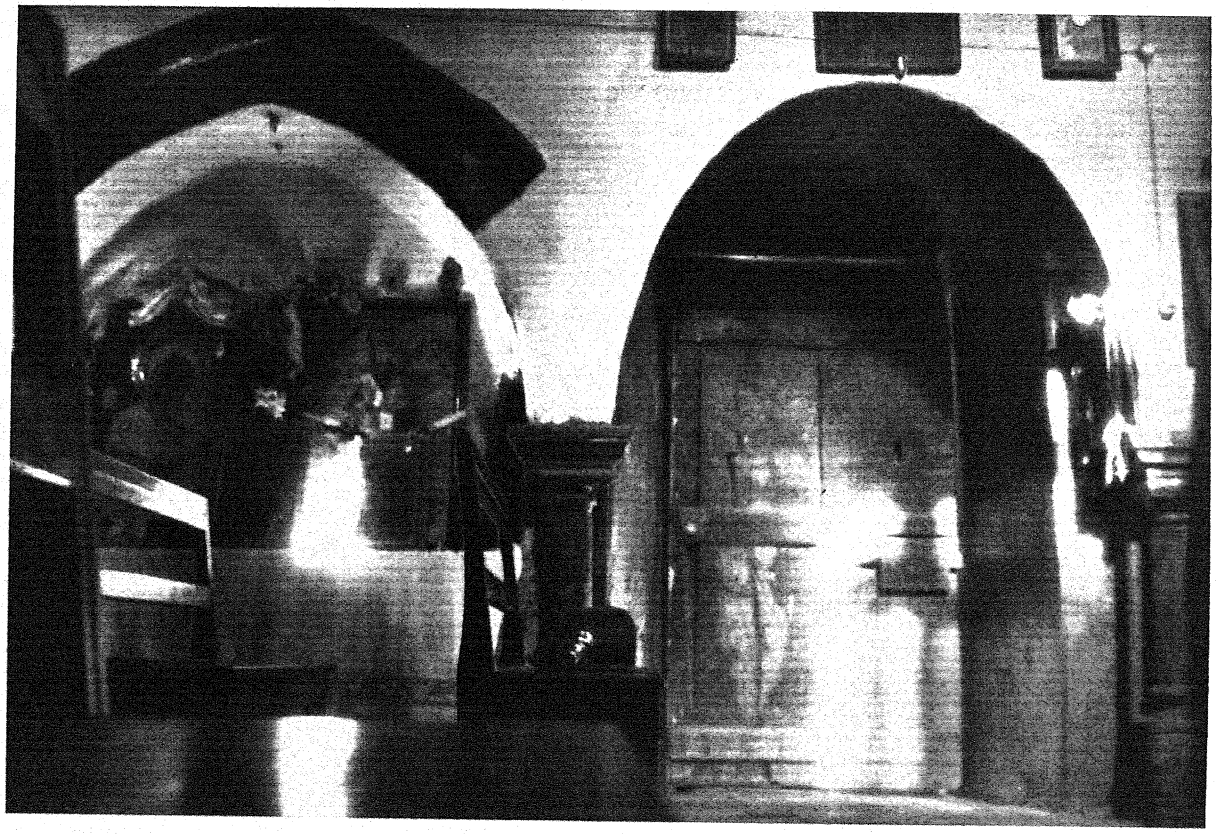


FIG. 102. WALL ARCADE. CHAPEL OF ST. JAMES

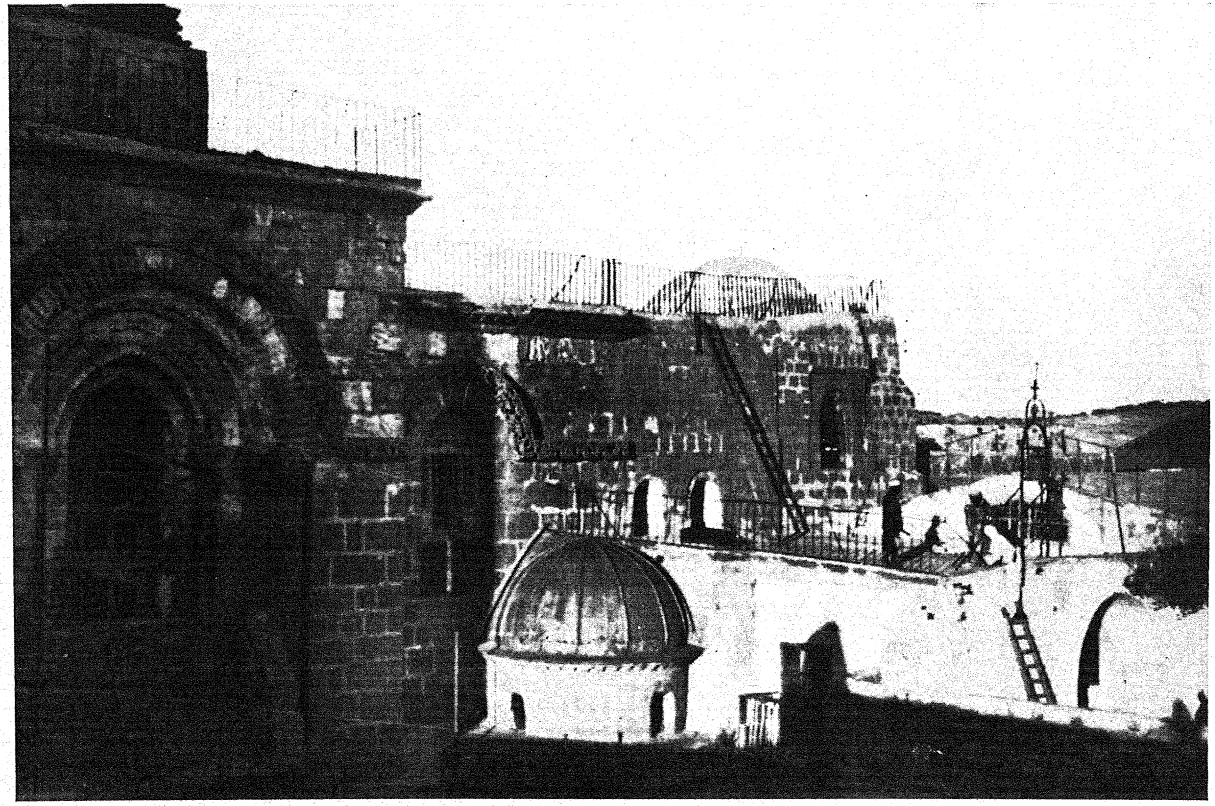


FIG. 103. SOUTH-EASTERN ANGLE OF BUILDINGS

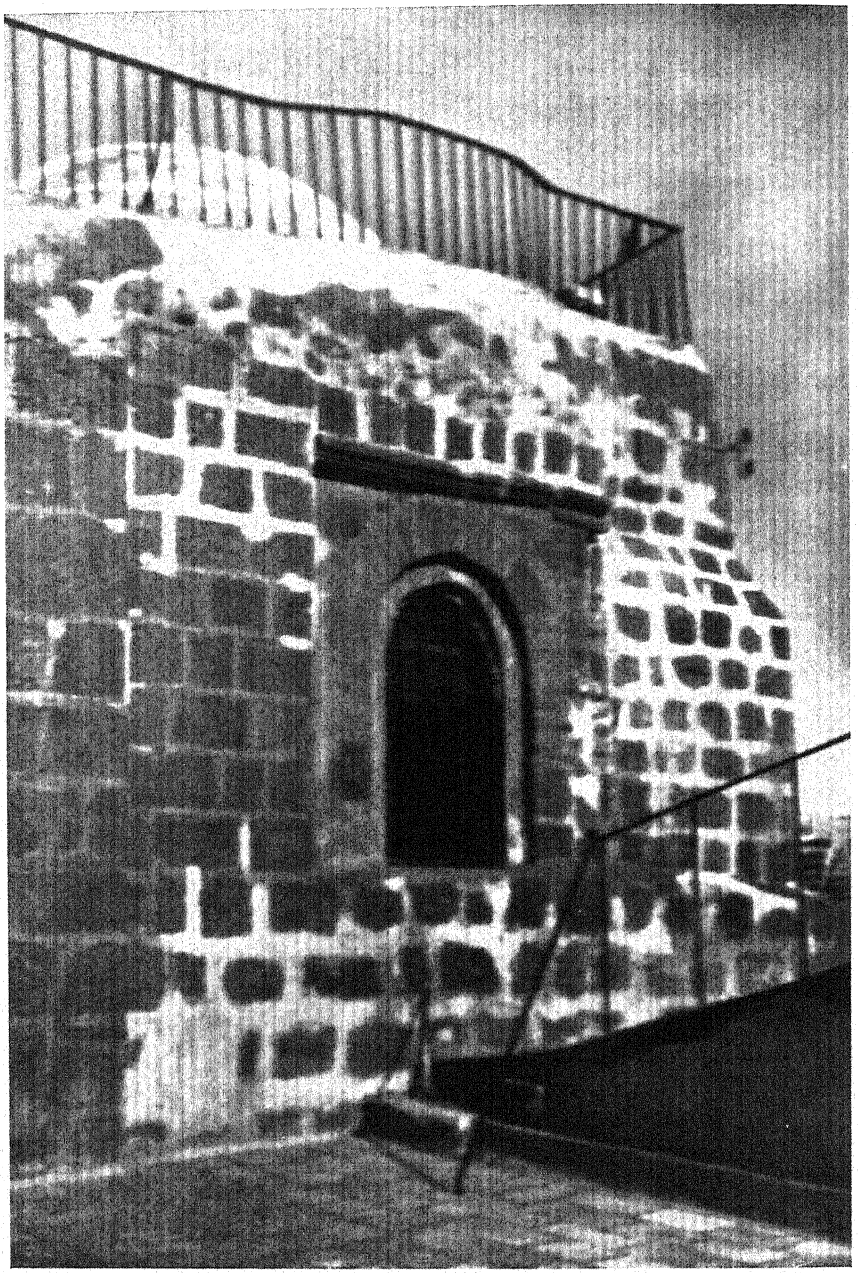


FIG. 104. BYZANTINE OCTAGONAL CUPOLA

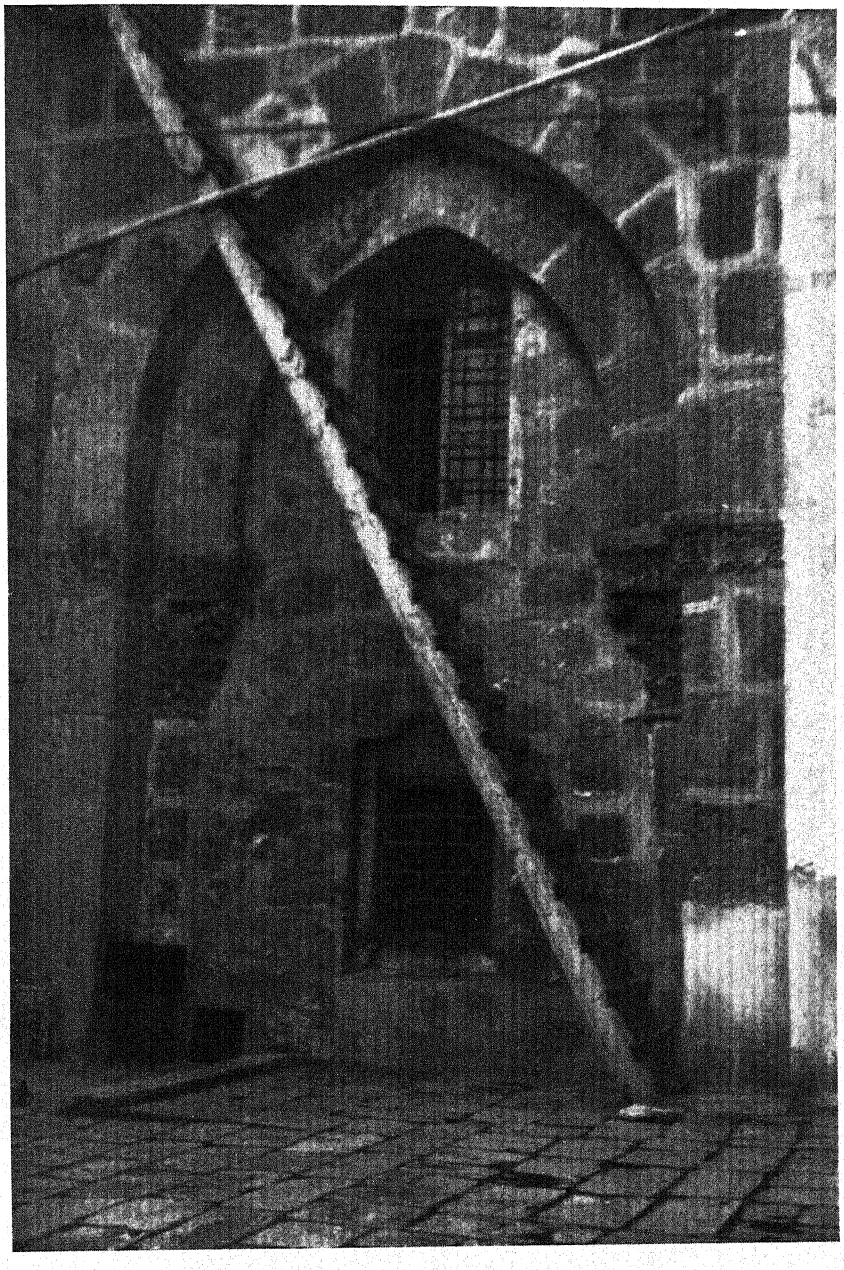


FIG. 105. OLD DOOR TO UPPER AMBULATORY

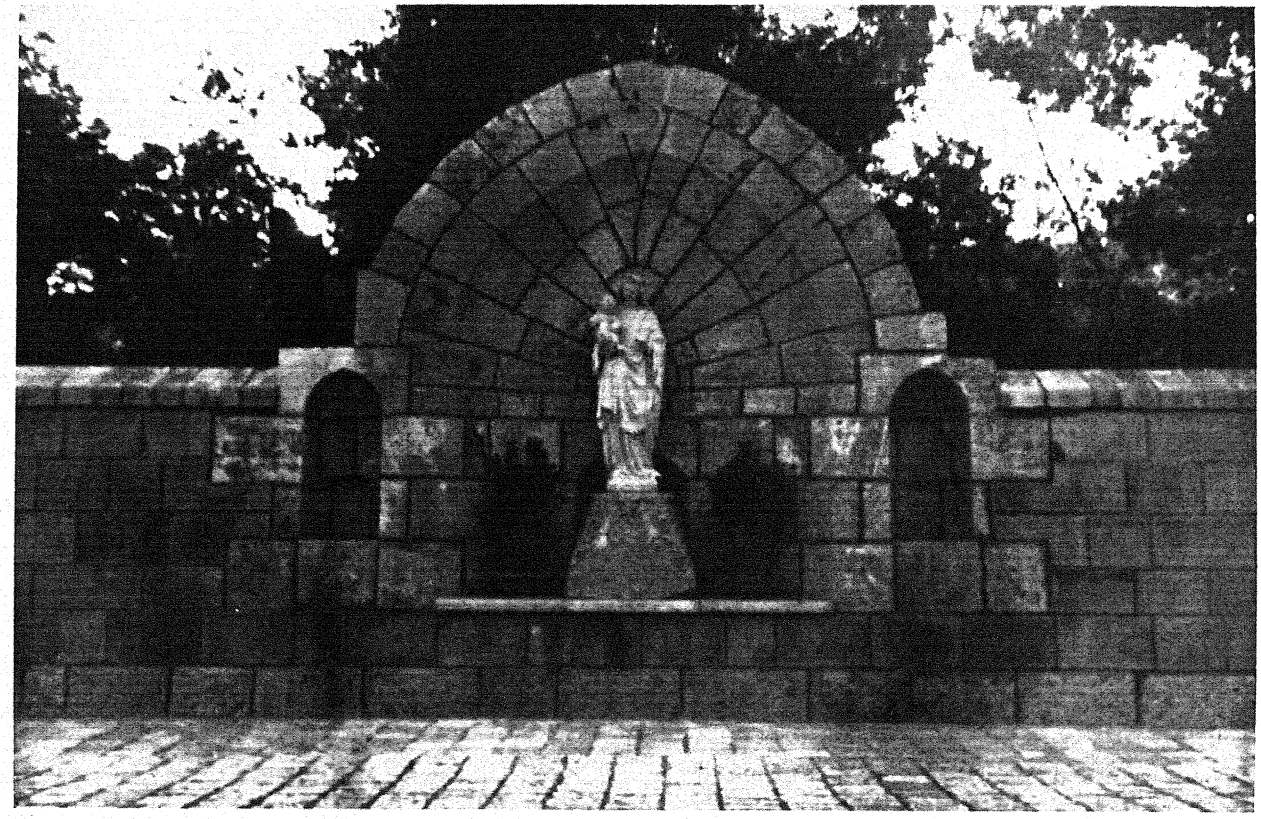


FIG. 106. NICHE FROM ROOF BY ROTUNDA, NOW AT ST. ANNE'S

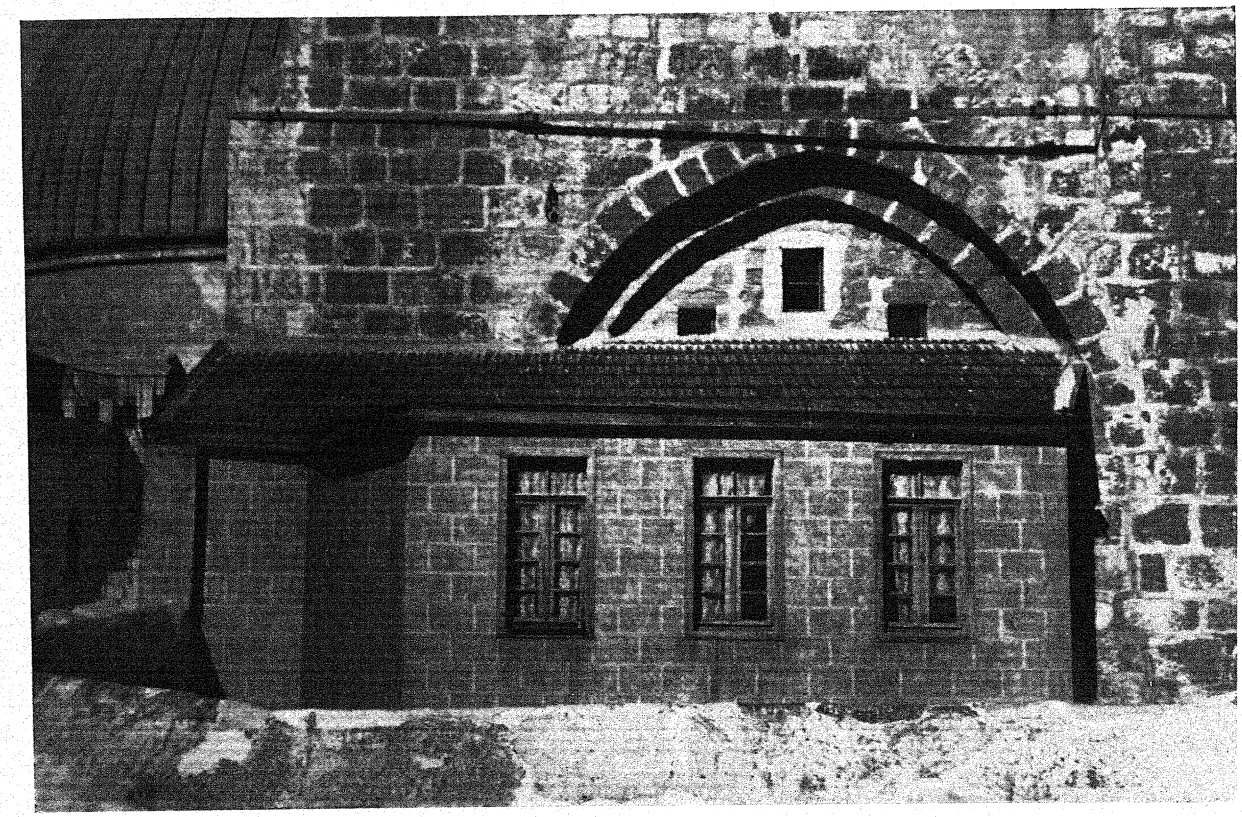


FIG. 107. MODERN ROOM ATTACHED TO TOWER

FIG. 108. EAST END

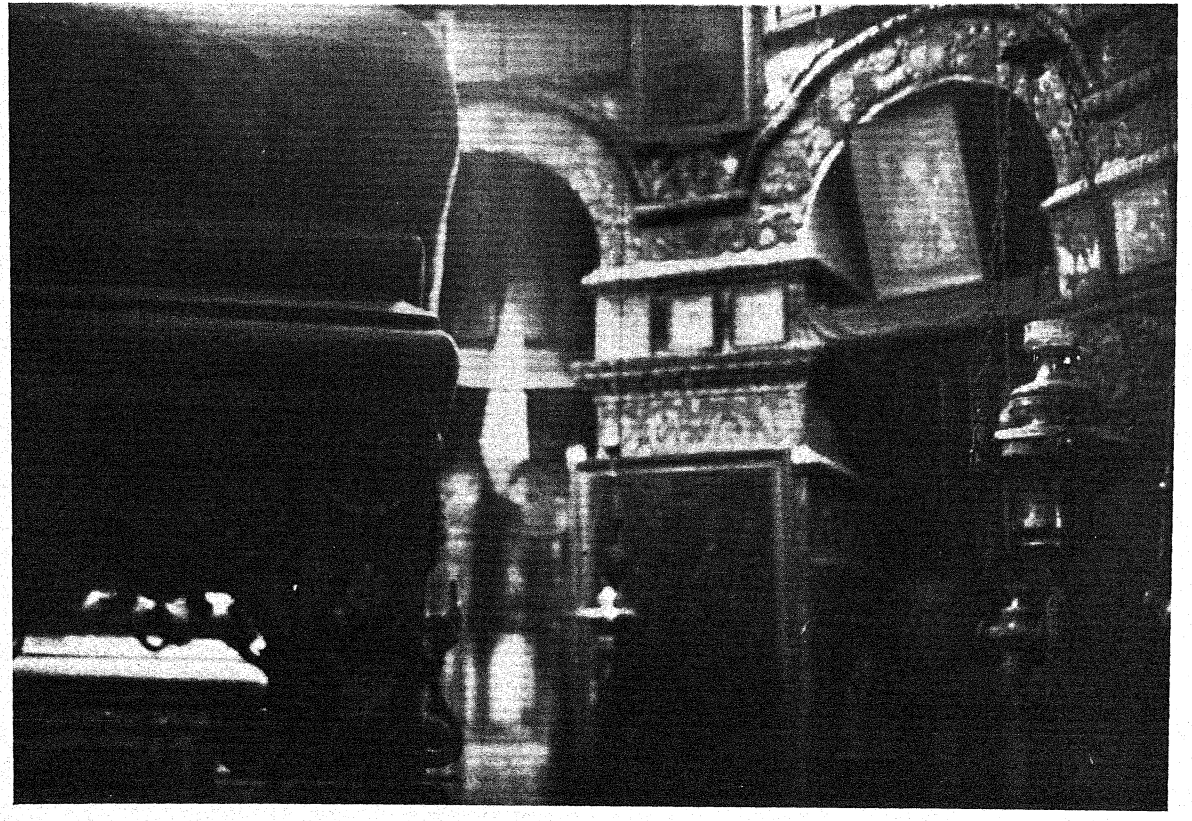
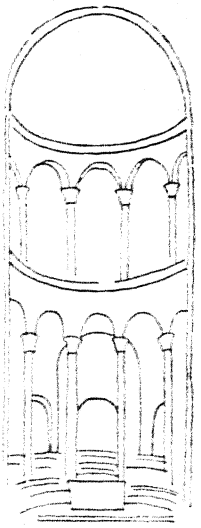
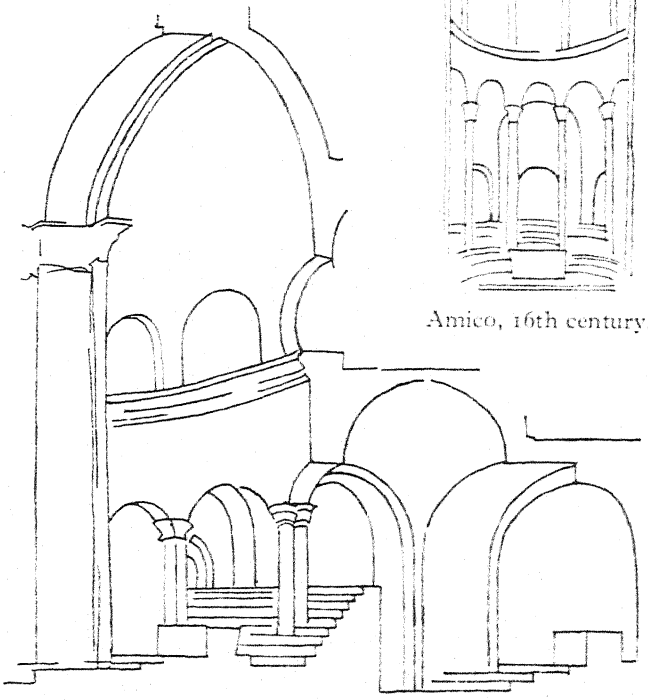


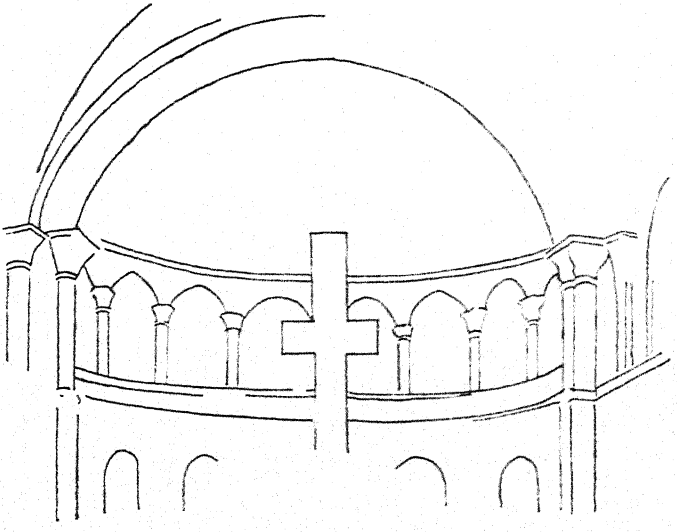
FIG. 109. PIERS OF APSE, AS BUILT IN 1810



Amico, 16th century.



Amico.



Le Bruyn, 17th century.

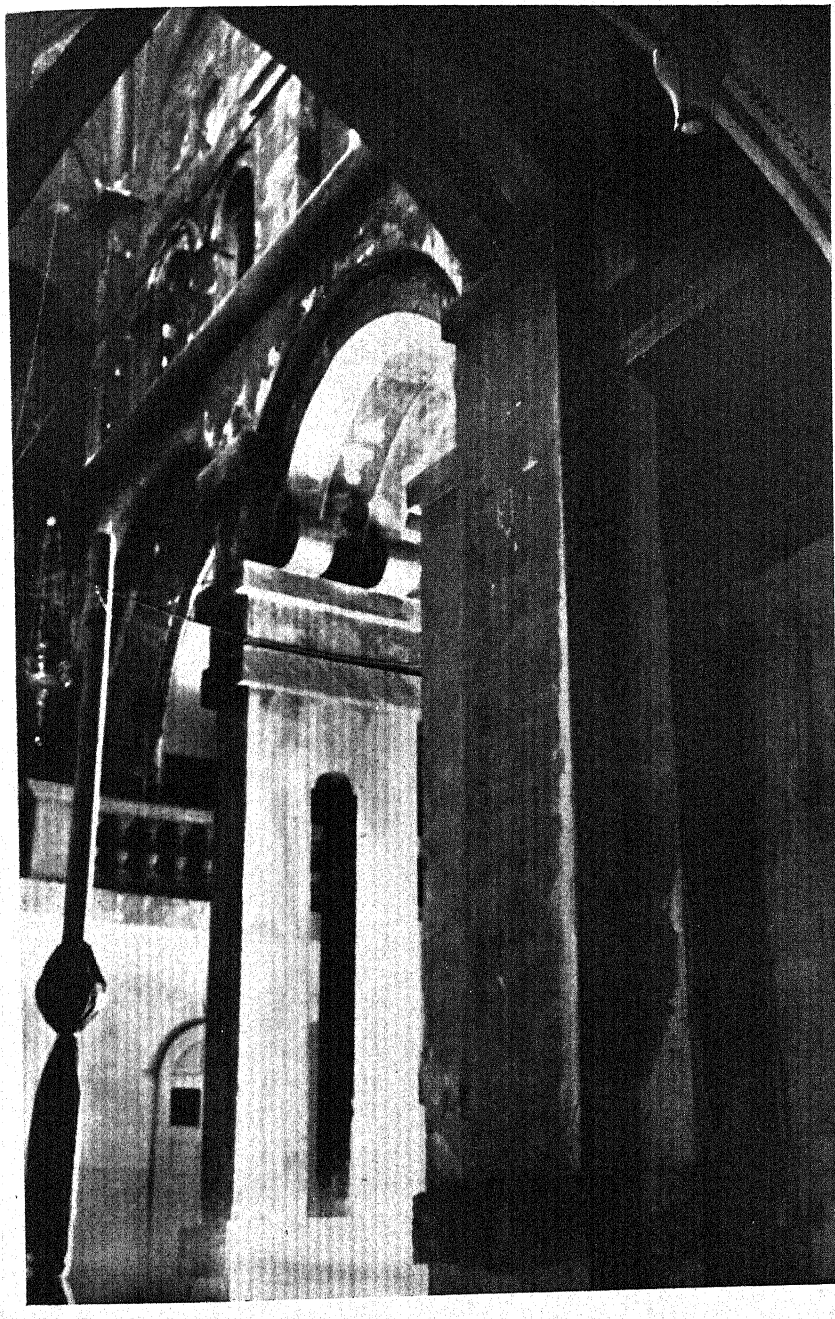


FIG. 111. SOUTH TRANSEPT, SHOWING 1810 WORK

FIG. 112. AMICO'S SIXTEENTH-CENTURY DRAWINGS OF THE SOUTH TRANSEPT

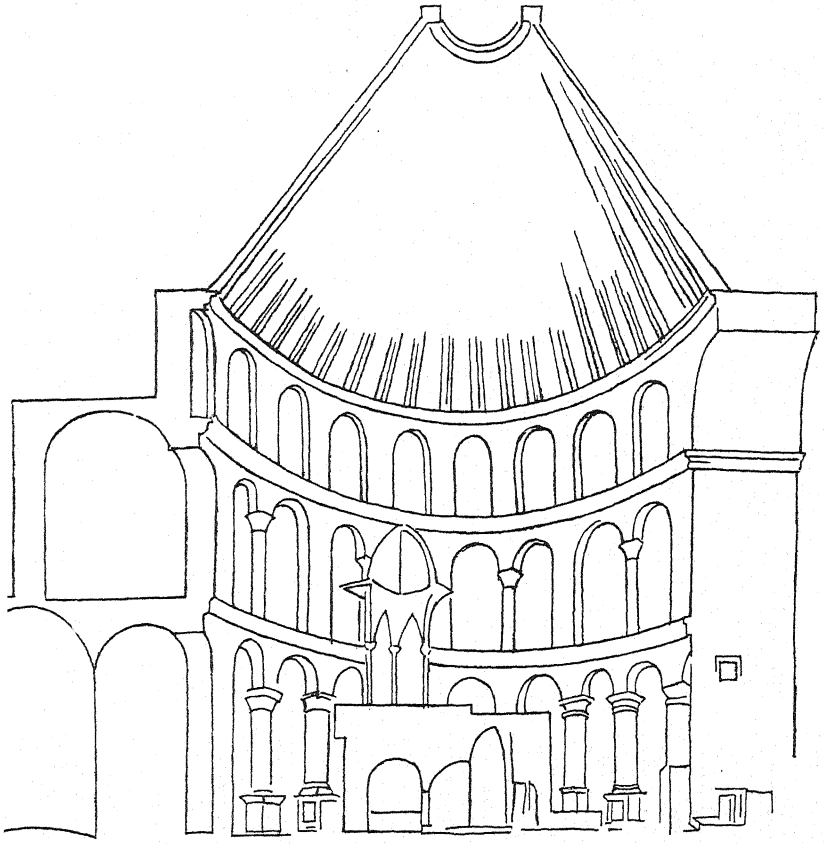


FIG. 113. AMICO'S SIXTEENTH-CENTURY DRAWING OF THE ROTUNDA

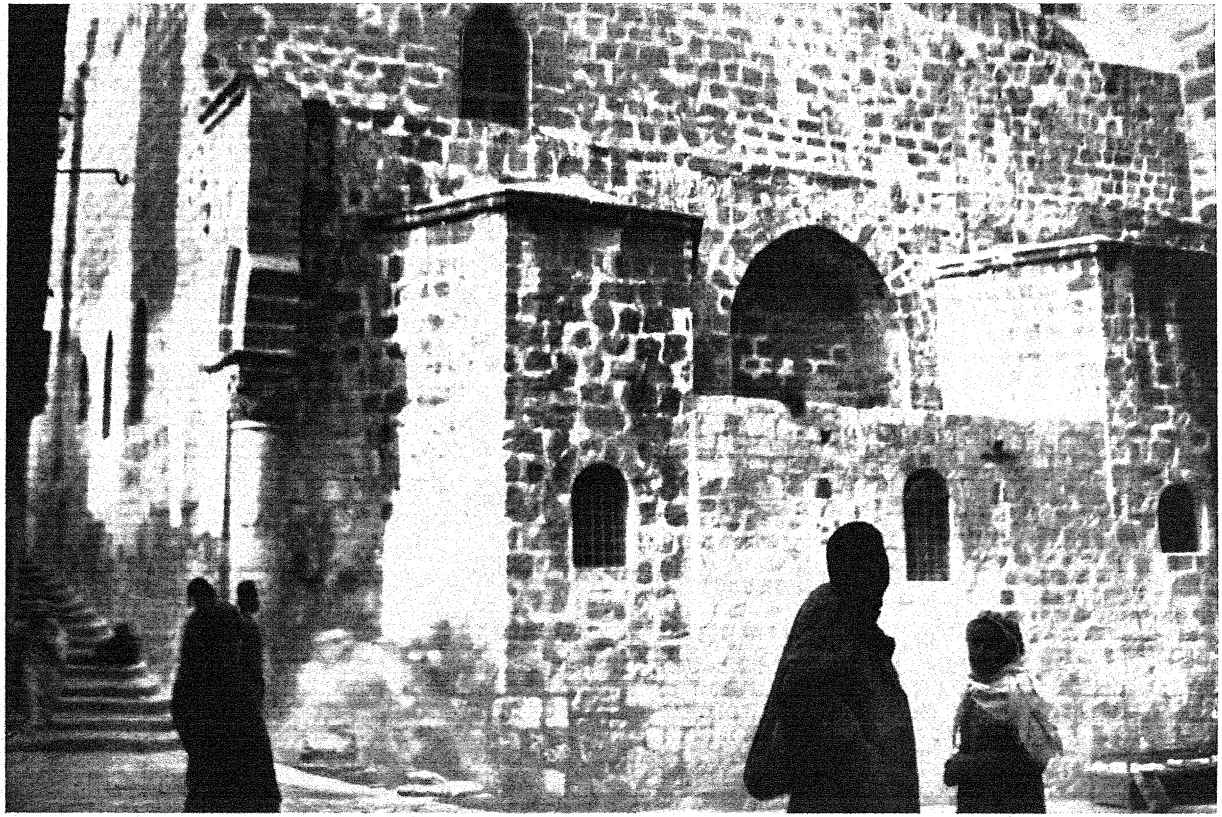


FIG. 114. WEST SIDE OF PARVIS

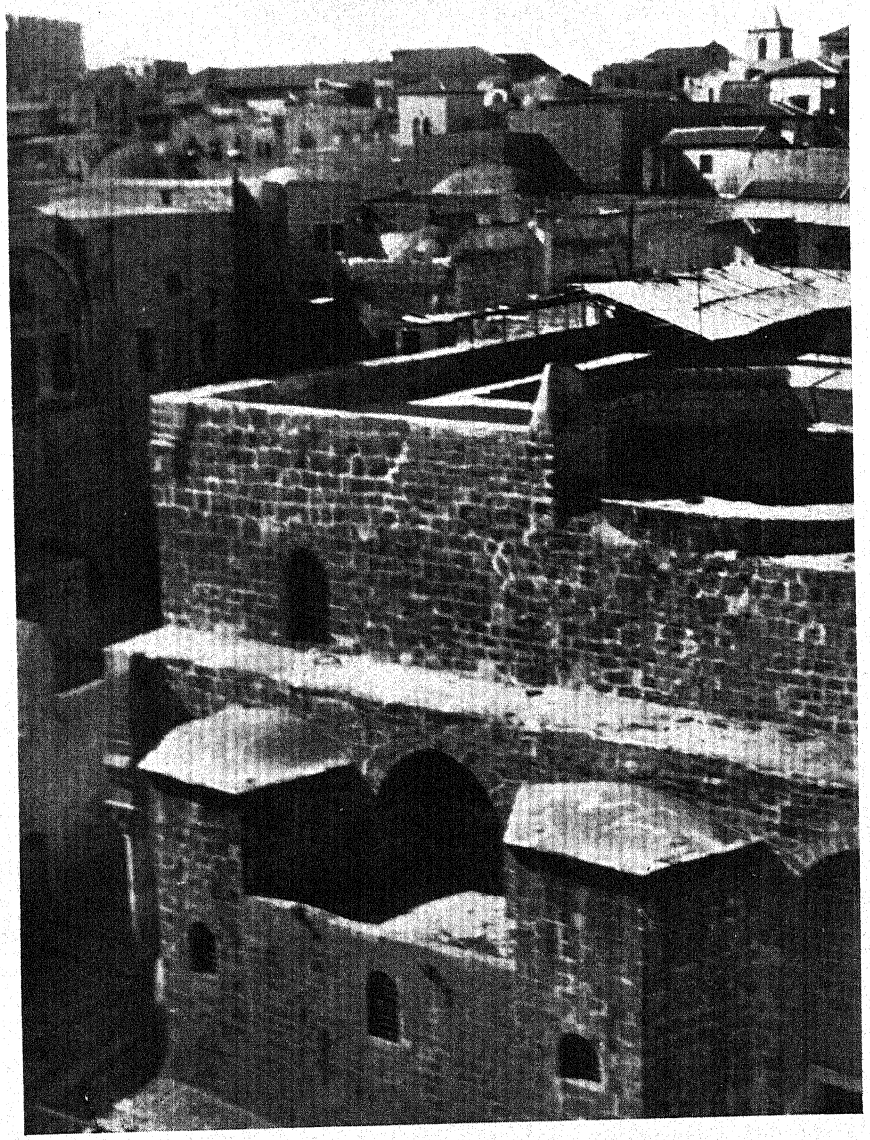


FIG. 115. OLD BAPTISTERY, ETC., FROM ABOVE

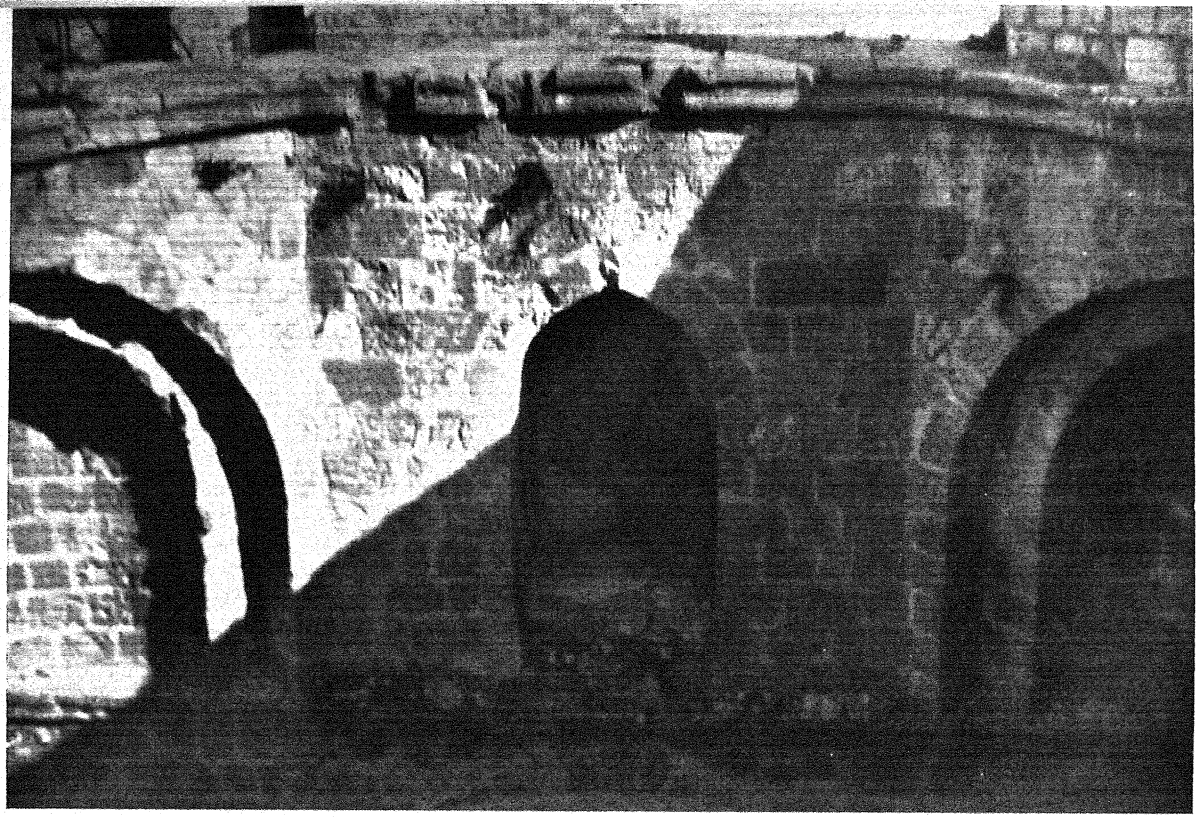
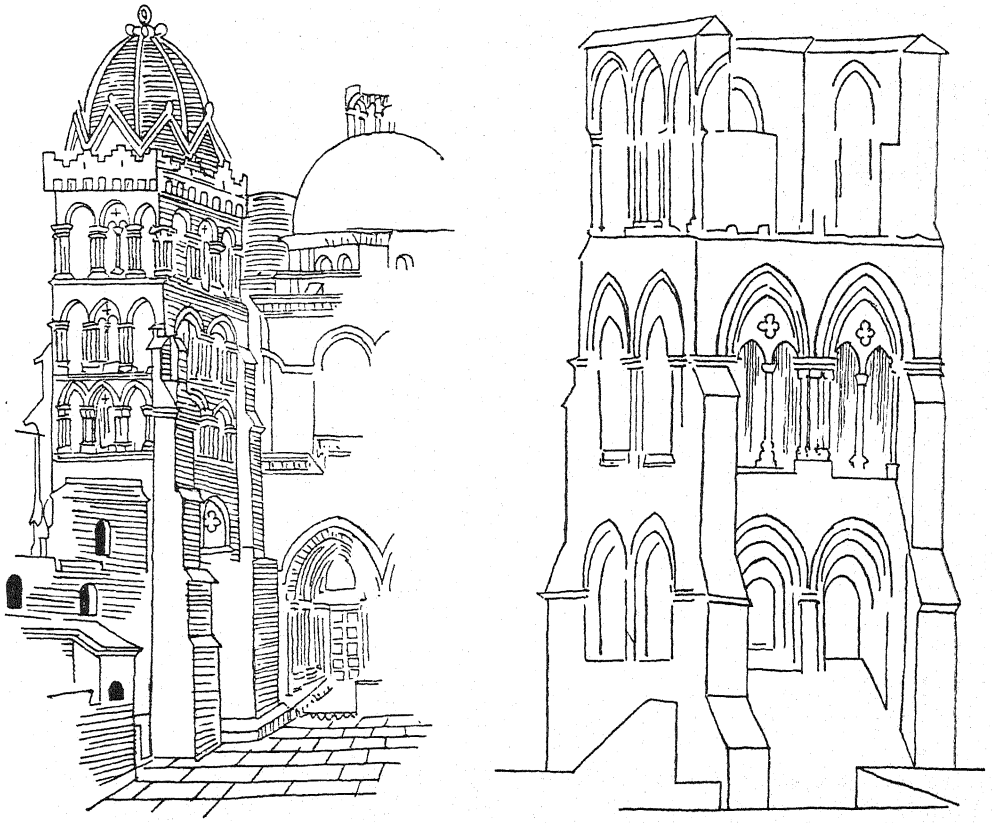


FIG. 116. EAST WALL OF OLD BAPTISTERY FROM WITHIN



Reuwich (in von Breydenbach) 1483.

Le Bruyn, 17th century

FIG. 117. OLD VIEWS OF THE TOWER

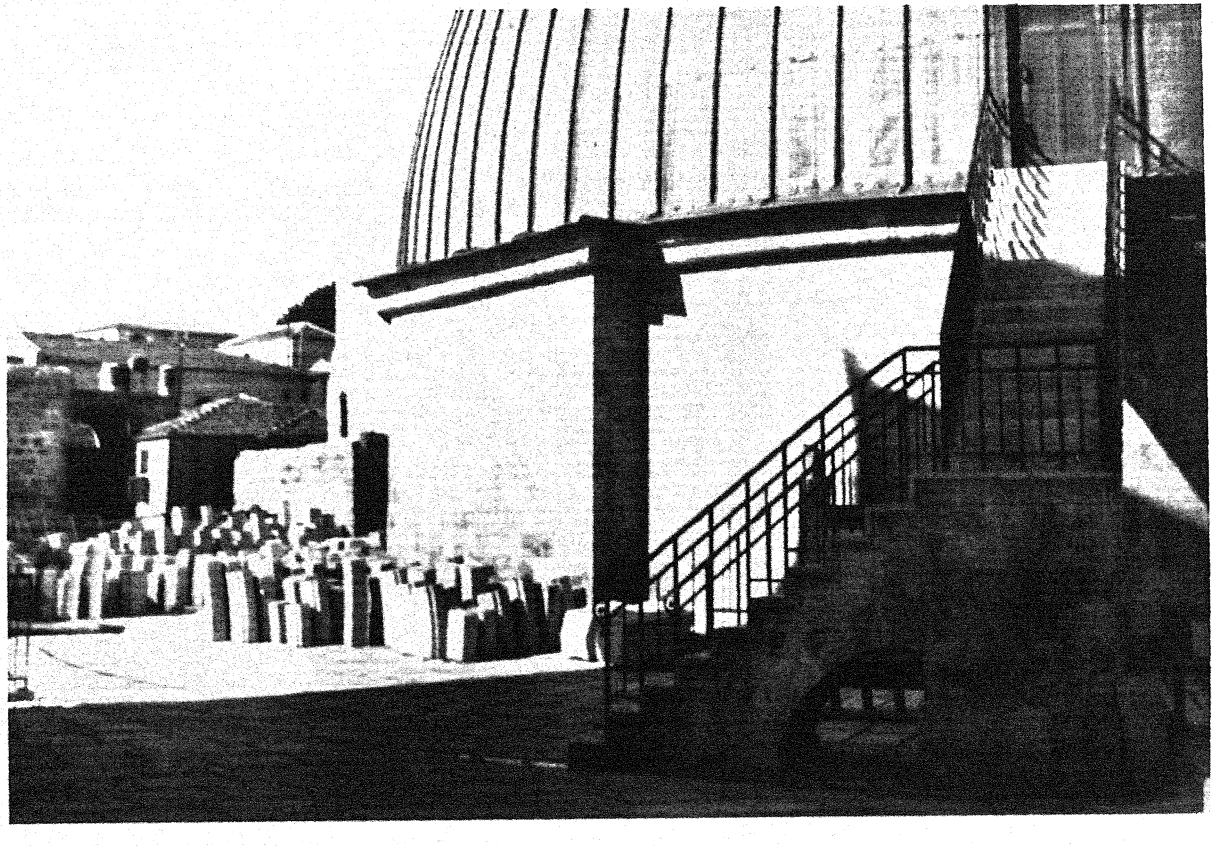


FIG. 118. MODERN DOME OVER ROTUNDA

FIG. 119. THE EDICULE OF THE SEPULCHRE

NOTE ON THE EDICULE

As the edicule of the Sepulchre itself does not form part of the fabric, it has not been mentioned in the body of this report. Its state is, however, one of serious decay, and steps should be taken to secure it from sudden collapse.

It seems very doubtful whether its age is sufficient to justify its retention in the event of extensive repair or alternative demolition being in question. Its design (see Fig. 119) is completely out of keeping with the original Church, and would appear still more so if the suggested alterations take place, restoring to the building as far as possible its earlier form.

If it is decided to rebuild the edicule, it should preferably be designed in accordance with the existing drawings of the earlier structure which lasted from the early sixteenth century to the fire of 1808. These drawings, prepared by Bernardino Amico at the end of the sixteenth century, are to scale, and give complete details of its design. It would therefore be possible to restore to the monument a central feature in harmony with the whole.